SCIENTIFIC AMERICAN

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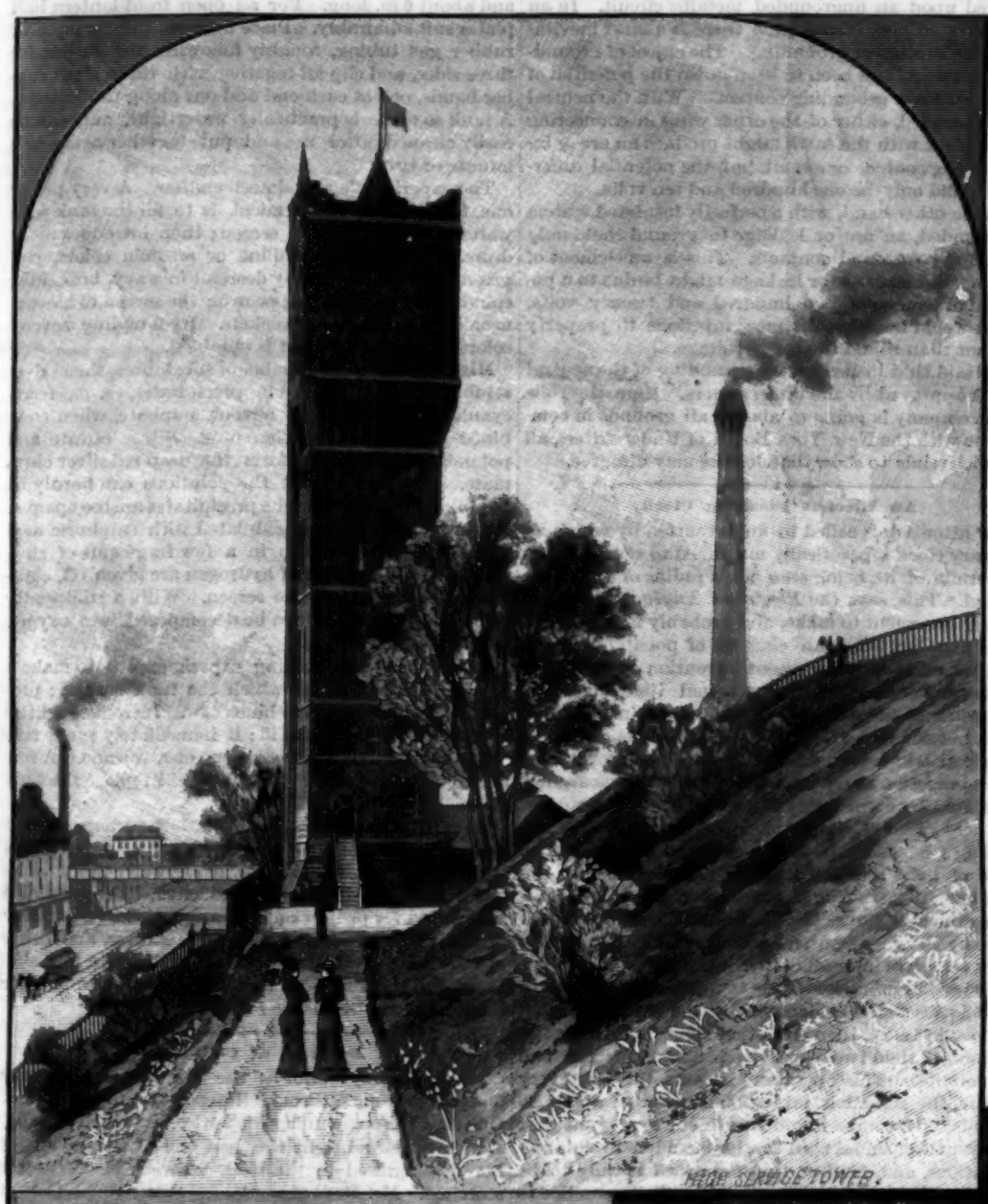

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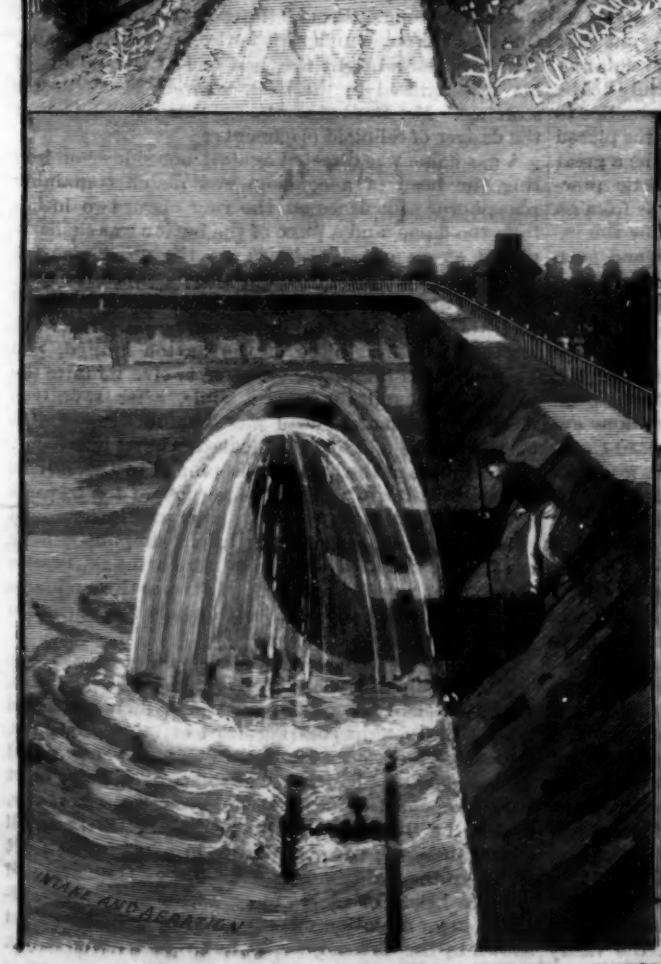

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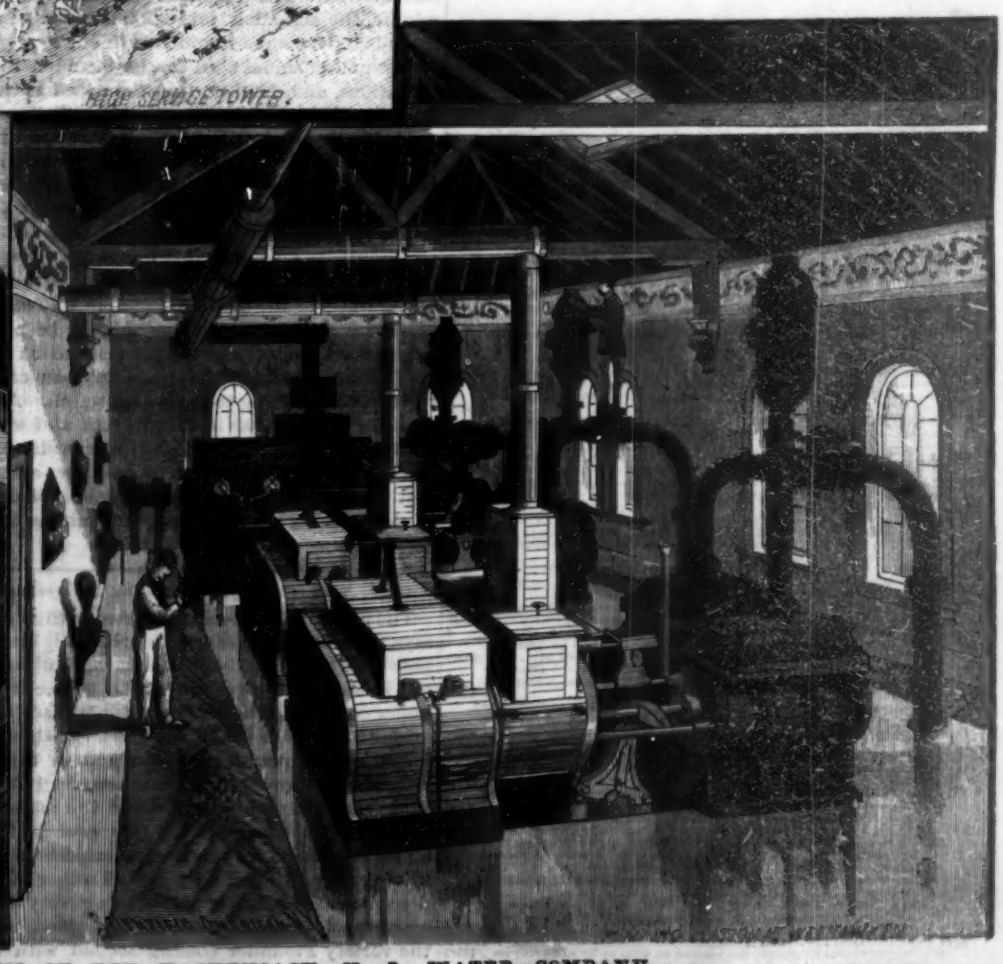

WATER SUPPLY SYSTEM OF THE HACKENSACK, N. J., WATER COMPANY.

THE HACKENSACK WATER COMPANY.

The Hackensack Water Company is a corporation for supplying water to cities, towns, and villages in Bergen and Hudson Counties of New Jersey. Hoboken, West Hoboken, Guttenburg, Ridgefield, Hackensack, Englewood, and Rutherford are among the places which its mains reach. It now supplies a population of over 100,000 people.

The intake is situated at New Milford, five miles above Hackensack, upon the Hackensack River. Here the river is crossed by a dam which shuts out all salt water. A branch or race leading from above the dam conducts the water into a settling tank and thence into a pump well. As there is a very large surplus of water, there is a constant overflow from the race.

One hundred and fourteen square miles of drainage area, including Rockland Lake and the southern portions of the Highlands in Rockland County, N. Y., are tributary to this supply. In different years the average daily flow of the river varies from 100 to 200 millions of gallons. With proper storage 50 to 60 millions of gallons can be obtained. The smallest daily flow on record is 14 millions of gallons. As the present consumption is about 6 millions of gallons, it will be seen that less than 5 per cent of the average flow is utilized. The drainage area is free from all pollution, and it is not believed it will ever attract factory interests or other sources of pollution.

Starting from the main pumping station at New Milford, two mains run to Weehawken, one 20 inch main going through Hackensack and another 24 inch main through Englewood. The mains come together at Ridgefield and thereafter run parallel to the main reservoir at Weehawken. Different branches are taken from them to supply some of the towns, while lines to other places run directly from the reservoir. As at present laid out, the town of Rutherford marks the termination of one set of mains. Eventually it is proposed to continue the lines therefrom back to the reservoir, thus abolishing all dead ends.

The New Milford station includes two batteries of steel boilers, supplying Worthington pumps. One six million gallon high duty and two three million gallon low duty pumps have been at work there for some time, and at present there has just been completed a ten million high duty pumping engine. In a recent

(*Continued on page 214.*)

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THE GROUNDING OF THE NEUTRAL WIRE IN THE THREE-WIRE SYSTEM.

The custom of grounding the neutral wire in the three-wire system has been for some time past adopted by several of the larger electric lighting companies using the Edison system of distribution. In this city and Boston, where there are many miles of mains, the companies felt that security to property and plant was conduced to by this practice. As executed, the neutral wire was grounded at junction boxes throughout the district and at the station. In no case whatever is the ground used as a return circuit.

Recently the New York underwriters have decided that the grounds must be removed, and the system worked upon an ungrounded metallic circuit. In an extensive subway distribution there is almost inevitably some leakage or grounding. The object of grounding the neutral has been to keep down the potential of possible arcs or grounding contacts. With the neutral wire grounded, either of the other wires in connecting by accident with the earth might produce an arc or incandescing contact or circuit, but the potential difference would only be one hundred and ten volts.

On the other hand, with a perfectly insulated system ungrounded, an arc or leakage to ground could only form by two ground contacts. This is an element of safety. But such arc or leakage might be due to a potential difference of two hundred and twenty volts, which would be apt to be more injurious to property or plant than would the lower voltage.

It is said that in Boston the grounding of the neutral wire is approved by the underwriters. Here the New York company is going to abolish all grounds in compliance with the New York Board of Underwriters, all of which tends to show that doctors may disagree.

An Electric Flashing Clock.

Our attention is called to an invention by which an ordinary clock is practically magnified to such a size as to permit of its being seen for a radius of fifty miles around. This, says the *Electrical Engineer*, London, is a big statement to make, and probably hardly credible at first, but it has an element of possibility in it. It is, we understand, a recent invention of Mr. H. Y. Dickinson, of London. The actual time-indicating clockwork is the same size as in an ordinary turret clock, but connected with it there is a second train of clockwork which is controlled by the clock proper, and is put in motion every minute, when it whizzes around (regulated by an ordinary fan governor) and actuates an electric flashing lens, in much the same way as the striking mechanism of an ordinary clock acts. The beam of light reflected into the sky goes through the movement of a striking hammer when the clock is indicating the even hour. This is, however, only one signal made by the apparatus. Another symbol is used for every complete interval of five minutes, and yet another for odd minutes. Thus, supposing the time to be 7:27, this would be denoted by the seven beats in the first instance, then five other signs (indicating 5 × 5 minutes), then two short sharp flashes for the two odd minutes. This operation is gone through every minute, the signaling taking on an average about 10 seconds. Of course it will be evident to any one that the system of signal used can be modified to suit any conditions, and, further, that the code has only to be understood to enable any one with a little practice to read this sky clock with ease. Such apparatus placed in the center of this vast metropolis might be a great boon to the inhabitants, and that after a little practice the time would be read off as easily as from an ordinary dial. There would be no excuse for the vagaries of time now indicated in most houses, and even public buildings, where, if the timepiece is within a few minutes of the actual time, it is allowed to pass. With this clock at work it would only be necessary to run to the front door to see the time so as to correct the kitchen clock, or for the City man catching his train in the evening to check his watch. At the present time many clocks in large offices and stations are electrically synchronized hourly from a standard clock, but this convenience has to be paid for, and is rather costly. Mr. Dickinson's clock would not only permit of clocks being synchronized, but watches too, and for no charge.

The Champion Potato in Ireland.

The potato is so closely identified with our sister isle, says the *Gardeners' Magazine*, that it is interesting to note from the recently published agricultural returns for Ireland the position of the respective varieties under cultivation. Our Irish friends place their greatest faith upon the Champion variety, which was first introduced in quantity into Ireland in the year 1880, after the failure of the potato crop in 1879, and since that year this potato has proved the mainstay of the country. No less than 79·7 per cent of the acreage under the potato crop in Ireland consists of Champion, leaving only 20·3 per cent for all other varieties, the percentage of some of these being very small. The number of acres in 1891 of Champion was 600,403, the variety Flounder coming second with the vastly reduced number of 55,836 acres; Skerry Blue next, with 18,889 acres; and Magnum Bonum next, with 17,081 acres. The total acreage under potatoes in Ireland in 1891 was 753,332, as compared with 780,801 in 1890, showing, therefore, a decrease of 27,469 acres, while it brings out the value of the Champion kind, a well named potato as far as the Irish are concerned. Since 1881, when the number of acres devoted to potatoes was 855,293, no less than 540,600 being occupied by Champions, this variety has kept a fairly even position.

Lantern Experiments.

Tanks can very easily be made. Take two pieces of glass narrow enough to slide into the lantern front, and about 6 in. long. For an open front lantern half plates suit admirably. Place between them a piece of rubber gas tubing, roughly following the outline for three sides, and clip all together with three stout rubber bands, one at each end and one along the bottom. A tank so made is practically watertight, and can be easily cleaned after use and put together again in a minute or two.

The experiments are almost endless. A very pretty one, though scarcely chemical, is to fill the tank with water and focus on the screen; then introduce a few drops of the various aniline or resorcin colors, red, green, mauve, etc. They descend in wavy, branching spirals, and, of course, appear on the screen to ascend, usually suggesting sky rockets. By mingling several colors a very pretty effect is obtained.

Mixtures of a great number of substances, themselves soluble, produce insoluble precipitates, *e. g.*, ferrocyanide of potash and ferrous sulphate, when combined, give rise to Prussian blue. Silver nitrate and potassium bichromate form the deep red silver chromate. For screen work the solutions can hardly be too dilute, as otherwise the precipitates are too opaque. Again, put some water acidulated with sulphuric acid into the tank, and drop in a few fragments of zinc. Multitudes of bubbles of hydrogen are given off, chasing each other across the screen. With a sufficiently strong battery, water can be decomposed into oxygen and hydrogen.

One of the most telling experiments is to make a solution of litmus, with which the tank is filled; projected, it appears a deep blue color. Introduce a little vinegar or other weak acid; it immediately turns red, the effect strongly reminding one of a volcano. A few drops of ammonia or any alkali will replace the blue tinge.

There is nothing new in all this, but perhaps it may be new to one or two of your younger readers. I was myself surprised to find how easily water-tight tanks could be made in the way indicated. They are also well suited for projection of the aquatic larvæ of many insects, water fleas, and similar creatures, and being rather narrow, they can be easily kept in tolerable focus, and squirm about the disk of light in a manner most comical.—*Amateur Photographer.*

Dangers of Celluloid.

Mr. C. V. Boys informs the London *Times* of the dangers to women through the use of celluloid buttons. One case has come under his notice, in which a lady, standing near a bright fire, had one of the buttons of her dress ignited by the heat, whereby her dress was scorched. Mr. Boys gives the following rough tests of the danger of celluloid ornaments:

A gas flame was directed against one side of an iron ring, the head of a common wax match containing phosphorus was placed on the ring about two inches from the flame, and a piece of the button was similarly placed at an equal distance on the other side. A second piece of the button was also placed on the ring, but at twice the distance from the flame. A small piece of paper was laid lightly over each. After five minutes, the first piece of the button ignited, and burned with a bright flame; after twelve minutes the second piece did the same; while, after seventeen minutes, the match head was still unchanged. On testing it with a light, it immediately burst into flame. A third piece of the button was pinned to the surface of an old duster, which for the purpose of the test was equivalent to a dress, and the duster was hung from a chair in front of an ordinary bright fire, but outside the fender, and at a distance at which the skirts of a dress might any day be found. In two or three minutes there was a cloud of smoke, and a hole was burned in the duster.

THE Bethlehem Iron Company, South Bethlehem, Pa., will make an extensive exhibit, including steel rails, a battle ship shafting 125 feet in length, guns, projectiles, an armor plate ingot weighing 100 tons, and various naval appliances. The company will also erect a full size model of its famous 125 ton steam hammer, said to be the largest in the world. It will be to all appearances a perfect duplicate in every respect. It will span the main avenue of Machinery Hall, and will rise to a height of ninety feet. At the last Paris exhibition great attention was attracted by a similar model shown by the Creusot works, but representing only a 100 ton hammer.

POSITION OF THE PLANETS IN APRIL.

VENUS

is evening star. She ranks first on the planetary annals of April, for her marvelous beauty and brilliancy and the interesting incidents that mark her course. She is in perihelion on the 3d at 3 h. A. M., but her orbit is so nearly circular that she is but 470,000 miles nearer the sun in perihelion than in aphelion, a short distance in celestial measurement. The most important event in her career is her arrival at greatest eastern elongation, on the 30th, at 0 h. 15 m. A. M., when she is 45° 34′ east of the sun. This, in one aspect, is the culmination of her course as evening star, for, though she continues to come nearer to the earth, and increase in size and luster, she then reaches the end of the chain that holds her to the sun. Not a second of arc farther east of the sun can she go, but bound to him by irrevocable law, she remains stationary for a short time, and then, with quickened pace, retraces her steps toward the great central luminary. Observers will note the change in her perceptible approach to the sun after elongation, and in the shorter time she remains above the horizon after sunset. A minor event on the April record is her conjunction with Neptune on the 12th at 0 h. 20 m. P. M., when she is 4′ 18″ north of Neptune, one of the phenomena to be seen in the mind's eye.

The moon, when three days old, makes a very close conjunction with Venus on the 29th, at midnight, being 3′ south. Crescent and planet will be below the horizon at the time of conjunction, but they will be near enough together to form a charming picture on the evening of the 29th. The conjunction becomes an occultation to observers who see the moon in her geocentric position, or as she would be seen from the center of the earth, and are also between the limiting parallels 41° north and 23° south.

The right ascension of Venus on the 1st is 3 h. 32 m., her declination is 21° 17′ north, her diameter is 18″.2, and she is in the constellation Taurus.

Venus sets on the 1st at 10 h. 5 m. P. M. On the 30th she sets at 10 h. 46 m. P. M.

URANUS

is morning star until the 23d, and then evening star. He is in opposition with the sun on the 23d, at 1 h. 49 m. P. M. The conditions are fine for the study of this planet, now easily visible to the naked eye as a faint star of the sixth magnitude, 15′ east or to the left of Spica, and a little to the right or west of Lambda Virginis, a star of the fifth magnitude. When the position of Uranus is once established, it will be easy to follow his course on moonless nights for several months to come. An opera glass will aid the observer, and so will patience and a practiced eye. A small telescope will be more satisfactory, for it will bring out the planet as a disk of a delicate green color.

The moon *occults* Uranus on the 12th. The immersion of the planet takes place at 11 h. 56 m. P. M., and the emersion occurs on the 13th at 1 h. 22 m. A. M., the occultation lasting 1 h. 26 m. The phenomenon will be very interesting, and must be observed with the telescope, in which the moon, soon after the full, and the little planet will present a charming picture.

The right ascension of Uranus on the 1st is 14 h. 11 m., his declination is 12° 41′ south, his diameter is 3″.8, and he is in the constellation Virgo.

Uranus rises on the 1st at 8 h. 8 m. P. M. On the 30th he sets at 4 h. 41 m. A. M.

MERCURY

is evening star until the 19th, and then morning star. He is in inferior conjunction with the sun on the 19th at 11 h. 1 m. A. M., when he ceases to be evening star, and appears on the sun's western side to commence his short course as morning star. Mercury continues to be visible to the naked eye during the first week of the month. He will be found farther north each evening, and at about the same distance, 9° northeast of the sunset point, as at the time of greatest elongation.

The moon, the day before the full, is in conjunction with Mercury, on the 25th, at 10 h. 1 m. P. M., being 1° 52′ south.

The right ascension of Mercury on the 1st, at noon, is 1 h. 53 m., his declination is 14° 30′ north, his diameter is 7″.8, and he is in the constellation Aries.

Mercury sets on the 1st at 7 h. 58 m. P. M. On the 30th he sets at 4 h. 21 m. A. M.

SATURN

is evening star. He is a beautiful object in the east in the early evening, as he makes his way toward the zenith, while his more brilliant rival, Venus, is descending in the east, too far distant to interfere with his lesser light. This is the case on the 1st of the month, for then Saturn is on the meridian about 11 o'clock, and Venus sets about 10 o'clock. It is different at the close of the month, when Saturn is on the meridian at 9 o'clock, and Venus sets about half-past 10 o'clock. The two evening stars will then shine in the western sky until Venus disappears.

The moon, three days before the full, is in conjunction with Saturn, on the 9th, at 3 h. 36 m. P. M., being 1° 49′ north.

The right ascension of Saturn on the 1st, at noon, is 11 h. 48 m., his declination is 4° 5′ north, his diameter is 18″.4, and he is in the constellation Virgo.

Saturn sets on the 1st at 5 h. 13 m. A. M. On the 30th he sets at 3 h. 15 m. A. M.

MARS

is morning star. There is nothing of special interest in his April course. Observers who desire to follow his course will find him on the first part of the month shining as a small ruddy star a short distance north of the dipper in Sagittarius, rising about half-past 1 o'clock in the morning.

The moon is in conjunction with Mars on the 19th, at 6 h. 25 m. A. M., being 3° 44′ south.

The right ascension of Mars on the 1st is 18 h. 51 m., his declination is 23° 28′ south, his diameter is 9″.0, and he is in the constellation Sagittarius.

Mars rises on the 1st at 1 h. 29 m. A. M. On the 30th he rises at 0 h. 37 m. A. M.

JUPITER

is morning star. He is still too near the sun to be visible. His advance in northern declination will bring him into more favorable conditions for observation, for several years to come, which is a hopeful state of affairs for astronomers who make a specialty of the study of the Jovian disk.

The right ascension of Jupiter on the 1st is 0 h. 16 m., his declination is 0° 30′ north, his diameter is 31″.6, and he is in the constellation Pisces.

Jupiter rises on the 1st at 5 h. 25 m. A. M. On the 30th he rises at 3 h. 48 m. A. M.

NEPTUNE

is evening star. His right ascension on the 1st is 4 h. 21 m., his declination is 19° 56′ north, his diameter is 2″.5, and he is in the constellation Taurus.

Neptune sets on the 1st at 10 h. 49 m. P. M. On the 30th he sets at 8 h. 59 m. P. M.

Venus, Saturn, Neptune and Uranus are evening stars at the close of the month. Mars, Jupiter, and Mercury are morning stars.

Yearling Fishes.

Two and a half millions of yearling fishes were planted last year, says the *Washington Star*, in the waters of the United States by the Fish Commission. This statement is more remarkable than it may seem. Up to 1886, all the fishes artificially hatched by the government were turned into the rivers and lakes to shift for themselves, as soon as they were out of the eggs. Consequently nearly all of them were devoured, and out of every thousand young fry but few were expected to survive and reach maturity. Five years ago a first experiment was made with the planting of 13,000 "fingerlings," that is, fishes which had attained a season's growth.

Before long all the fishes artificially propagated for planting in this country will be allowed to get a year's growth before they are let loose. It has been found that one acre of water will accommodate 500,000 fry from the time they are hatched to the condition of fingerlings. Under such circumstances 50 per cent of the baby fishes survive the season, at the end of which they are able to take care of themselves and have passed the danger point. In other words, when permitted to escape and look out for themselves in the streams or elsewhere, they mostly escape destruction and reach mature fishhood.

Pretty soon this plan will be exclusively pursued in the propagation of shad for stocking the rivers. Conveniently near to each stream will be established suitable ponds. The fish commission will simply hatch out the fry and send them immediately to these preserves, where they will be permitted to grow to a finger's length before they are let go. Fishes only grow during the warm season, so that at the end of four months, when hatched in spring, they are yearlings in size. A pond 100 acres in extent will accommodate 50,000,000 of shad fry, and at the end of 120 days communication with the river can be opened and 25,000,000 little fishes will swim merrily away, to return in future years of a marketable size.

Unlimited quantities of shad eggs are always obtainable in the season, and as many millions of them can be hatched in glass jars as are desired. Thus the result to be secured by artificial culture in any river is only limited by the pond area used. A majority of the fingerlings let go will certainly live to grow up and swell the schools which annually visit the streams for spawning. Exactly the same proposition applies to other kinds of fishes. The fish commission is at present rearing trout and salmon on a like principle and with similar results. A large pond is now being prepared at Gloucester, Mass., for stocking with newly hatched codfish, which will be put into the sea as yearlings. In this way it is hoped that the catch of this valuable food fish along the New England coast will be greatly increased after a while.

The same method would be tried with lobsters, but for the fact that these pugnacious crustaceans cannot be made to grow up together peaceably. You put a dozen newly hatched specimens into an aquarium, and within a few days there will be only one—a large, fat, and promising youngster. He has eaten all the rest. Therefore, baby lobsters have to be let loose in the ocean when they are just out of the egg, and in this plan not much profit is found, because they are quickly gobbled by fishes. The fish commission is hatching 5,000,000 of young lobsters yearly. Once upon a time, not many years ago, 25 pound lobsters were not infrequently captured, and there is record of 40 pound specimens, but such giants are no longer seen, because they do not have a chance to get very big before they are taken by the fishermen.

One of the most profitable branches of the fish commission's work consists in stocking the streams, ponds, and lakes all over the West with the native fishes of the Mississippi Valley. They are taken in great quantities in puddles big and small, where they are left by the retreating waters after the floods, and are shipped alive to various parts of the Union. Thus black bass, rock bass, pike, perch, crappies, spotted catfish, and other species are being distributed throughout the United States very plentifully. Trout of six kinds have recently been introduced successfully to the Yellowstone Park region—a territory as big as the State of Rhode Island, which has hitherto been practically bare of fish.

An Improved Form of Induction Coil.

BY H. N. WARREN, RESEARCH ANALYST.

The original construction of induction coils known as the continuous wind, constituting what is known as the secondary coil, has been of late superseded by what is termed the segment wind, differing both as regards its insulation and also in its effects when compared with the former system. The following description of a machine of this construction will afford a brief idea of the benefits derived over other systems, when every advantage is taken in manufacturing an article of this description to avoid, if possible, the use of impure elements:

In this case the primary core was prepared by precipitating pure oxide of iron, igniting, and reducing it in a current of hydrogen gas; afterward, fusing and forging the same. Of this substance, 10 lb. of wire, about the thickness of a wax match and a foot and a half in length, was selected, a pure iron rod composed of the same substance also passing through the center. This core was covered with several layers of paraffined silk, over which was wound 4 lb. of very thick insulated copper wire, each layer being carefully insulated; the whole being inclosed, save the extremities, in a thick ebonite tube. Upon this was mounted the secondary, consisting of 25 lb. of No. 22 double silk-covered wire; on the whole this may be regarded as a thick wire, but the strength afforded, both as regards the spark obtained and also the amount of current allowed, was well merited. The secondary was composed of 52 segments, each separated from each other by mica plates; the whole being coated with paraffin to about 2 inches in depth, being further cased in ebonite. To the contact breaker of the machine, in order to absorb the spark, were connected 500 sheets of copper foil, each being insulated by paraffined silk and protected in the usual manner. The machine, as now constructed, required five Bunsen quarts to urge it to its full. The spark thus obtained, which was nearly 15 inches in length, was the most intense I have ever seen. In some instances, the sudden discharge was equivalent to the report of a rifle, affording a constant stream of thick fire resembling lightning. The supply of ozone liberated was very considerable, almost immediately bleaching cotton fabrics when brought near the same in a moist condition; two dozen large vacuum tubes, 2 feet long and upward, were instantaneously lighted; and deal boards, to the thickness of half an inch, were readily pierced; almost every elementary substance was speedily volatilized when brought in contact with the spark, and their spectra thus revealed by the aid of that instrument.—*Chem. News.*

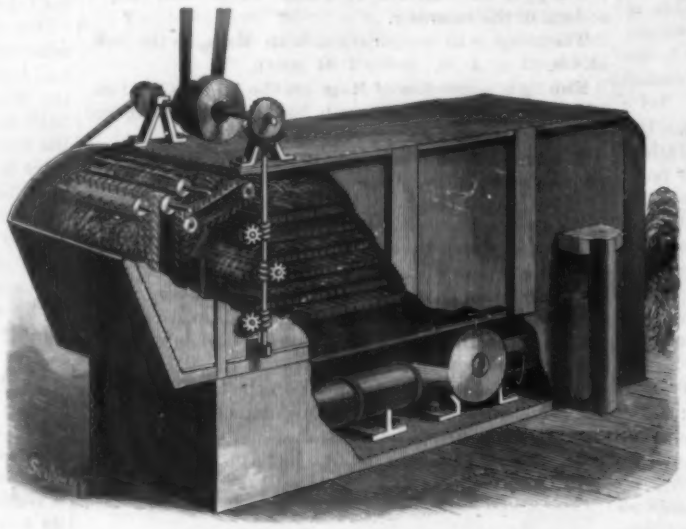
A New Storage Battery Car.

The Woodland Avenue and West Side Street Railroad Company, of Cleveland, O., has been testing a new storage battery car, with the view of equipping its lines with the same should the test prove successful. The car which is being tested is one manufactured by the Ford & Washburn Electric Company, of Cleveland, and is called the "Ideal." It measures 21 ft. inside over all and is equipped with 180 cells, which are placed under the seats, serving to operate a forty horse power Ford & Washburn motor. One charge, it is stated, is sufficient for fifty miles on an ordinary track. A recent issue of the Cleveland *World*, referring to the new car, had the following:

"Supt. Mulhern, of the Woodland Avenue and West Side Street Railroad Company, is very much pleased with the system, and says that it is very probable that it will be adopted by the company. The new car will be run on the Woodland line among the other cars for a few weeks as a further test. It will make all the regular stops to pick up and let off passengers, and if this proves satisfactory, a large order for cars will at once be placed with the company."

AN IMPROVED WOOL DRYING MACHINE.

A simple, easy running, and compact machine is shown in the illustration, which is designed to thoroughly dry a large quantity of wool, lightening up the wool and drying it in such a manner that its fiber will not be injured, the machine being kept at the required temperature with only a small consumption of steam. This improvement has been patented by Messrs. John R. Mellor, of No. 227 E. Cambria Street, Kensington, Philadelphia, Pa., and James M. Mellor, of Clifton Heights, Pa. The machine has at one end a hopper, in which is a common form of vertically arranged spike apron, to feed the wool into the machine, and in the front side of the hopper, near the apron, is a comb, consisting of a roller and three series of curved teeth, to lighten up the fibers of the wool. A little above the feed apron, and between it and the main case, is a brush which takes the wool from the apron, this brush being just above an opening in the main case, extending through which is an intermediate carrying apron, running on the usual rollers, and its inner end being above the upper main carrying apron. This is a simple form of apron carried by revoluble sprocket wheels, and delivers to a similar apron immediately beneath it, and the latter delivering on another apron in the lower portion of the case. The aprons are driven by differential gears, so that their speed may be regulated, and they travel in different directions to give a continuous movement to the wool, from the feed opening to the outlet, at the rear end of the machine, beneath the end of the lower apron, where a carrying apron receives and carries out the dried wool. Beneath the floor of the case is an exhaust blower, by which the moist air is drawn out, the blower also forcing a fresh supply of air over heating coils, so that a constant stream of hot air is being passed into the machine as the cool moist air is passed out. The machine may, with but slight changes, be readily adapted to drying a great variety of fibers and other material.



MELLOR'S WOOL DRIER.

TWELVE-WHEELED FREIGHT LOCOMOTIVES.

The Brooks Locomotive Works, of Dunkirk, N. Y., have recently furnished the Great Northern Railway with fifteen of the heaviest locomotives in use in this country. The general appearance of these engines may be seen by reference to the accompanying illustration. The cylinders of the first ten of these engines are 20 by 24 in., five of the ten having wagon top and five Belpaire boilers. The other five have Belpaire boilers and cylinders 20 by 26 in., which is the engine shown in our illustration. The general dimensions of the engine, as given in the *Railway Review*, are as follows:

Driving wheels, eight in number	55 in. diameter
Fuel	bituminous coal
Rigid wheel base	9 ft. 8 in
Total wheel base of engine	25 ft. 2½ in
Total wheel base of engine and tender	52 ft. 3½ in
Diameter of boiler at smoke box end	66 in
Boiler material, homogeneous steel plates	⅝ and 9-16 in. thick
Throat sheet, thickness	11-16 in
Longitudinal seams, quadruple riveted, lapped	1 in. rivet
Waist connection seams and junction of waist with fire box	double riveted
Smoke box diameter	60 in
Front flue sheets, thickness	⅝ in
Rivets, in single riveted seams, diameter	1 in. not over 2⅝ in. center to center
Rivets, in double riveted seams, diameter	1 in. not over 3⅛ in. center to center
Dome, diameter	31 in
Dome, height	34 in
Boiler pressure, tested	220 lb
Mud ring, double riveted, thickness	3½ in
Water space tapers from 3½ in. at mud ring to 5 in. at crown sheet	
Stay bolts in top row and corners of sides and back, 1 in. in diameter, double pitch.	
Number of tubes	250
Diameter of tubes	2¼ in
Length of tubes	13 ft. 10 in
Spacing of tubes	vertical rows
Water space between tubes	not less than 15-16 in
Gauge of tubes	No. 11 B. W. G
Length of fire box	114 in
Width of fire box, at inside ring at bottom	38 in
Width of fire box at crown sheet	62 in
Fire box material	homogeneous steel
Crown sheet, thickness	½ in
Side and back sheets, thickness	5-16 in
Fine sheets, thickness	⅛ in
Water space at back and sides	3½ in
Water space in front	4 in
Stay bolts, diameter	⅞ in. and 1 in
Center to center of stay bolts, not over,	4¼ in
Center to center of Belpaire direct stays, not over	4¾ in
Stays on crown sheet fitted with 1 in. nut	on fire box end
Smokestack, diameter	17 in
Smokestack, material	steel, taper pattern
Grate, rocker	arranged to shake in two sections
Throttle and dry pipes, diameter	7 in
Safety valves, three in number	set to 180, 181, and 182 lb
Steam ports, length	18¼ in
Steam ports, width	1¾ in
Exhaust ports, length	18½ in
Exhaust ports, width	3 in
Bridges, width	1¼ in
Valve seat, distance raised above steam chest seat	1⅛ in
Piston rods, diameter	3¾ in
Piston rods, material	cold rolled steel
Piston and valve steam packing	the Jerome
Guides, material	hammered iron, case hardened
Guides, top, width	6½ in
Guides, bottom, width	4¼ in
Crosshead pins, diameter	4¼ in
Crosshead pins, length	3¼ in
Center to center of link eyes	13 in., links to be made solid
Valves	Richardson's balanced
Engine truck, type	Rigid center
Engine truck wheels	Krupp No. 1, O. H. tire
Engine truck axles	best hammered iron
Engine truck journals, length	10 in
Engine truck journals, diameter	5 in
Tires, thickness	3¼ in
Tires flanged	second and fourth
Width of tires flanged	5¼ in
Tires, plain	first and third
Width of plain tires	6¼ in
Driving axle journals, diameter	8 in
Driving axle journals, length	9 in
Driving axle material	steel
Wrist pin, main	6 by 6 in
Wrist pin, material	cast steel
Coupling rod pin	7 by 5 in
Coupling rod pin	5 by 5 in
Coupling rod pin	4¼ by 4¼ in
Tender wheels, diameter	33 in
Tender wheels, type	Krupp No. 1, O. H. steel tires
Tender truck axles	M. C. B. 60,000 lb
Tender truck axles, material	hammered iron
Capacity of tender tank	4,000 gal
Boiler lagging	wood
Boiler jacketing	planished iron
Cylinder lagging	wood
Cylinder jacket	sheet iron, painted
Brakes	New York Air Brake Co.'s schedule N. Y. 8
Brake shoes	Ross-Meehan
Weight on each driving wheel	about 17,000 lb
Weight on all driving wheels	136,000 lb
Weight on engine trucks	about 20,000 lb
Total weight of engine	about 156,000 lb
Average weight of engine and tender	115 tons

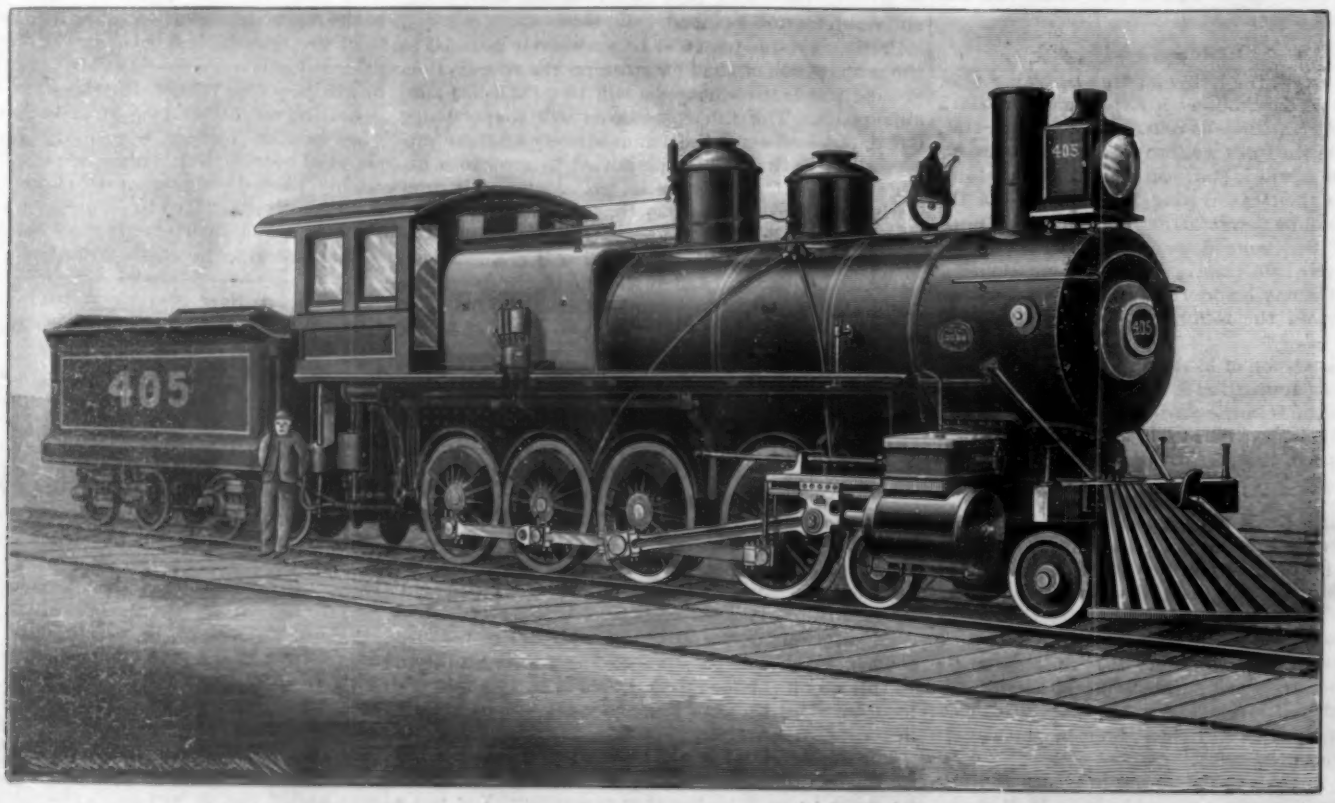
This locomotive will haul, in addition to its own and the weight of the tender, the tracks being in good condition and comparatively free from curves:

On a level	4,505 tons of 2,000 lb
On a 20 ft. grade	2,010 tons of 2,000 lb
On a 40 ft. grade	1,271 tons of 2,000 lb
On a 60 ft. grade	901 tons of 2,000 lb
On a 80 ft. grade	717 tons of 2,000 lb
On a 100 ft. grade	578 tons of 2,000 lb

Women's Inventions at the World's Fair.

Mrs. Potter Palmer, the president of the Board of Lady Managers of the World's Columbian Exposition, recently paid a visit to Commissioner Simonds, at the Patent Office, Washington, to ascertain what could be done in the way of exhibiting the inventive genius of women as shown by their patents on file. The commissioner suggested that the best plan would be to select from the 3,000 patents issued to women the ones that in the opinion of the Fair Committee seemed to be the most notable and worthy of exhibition. In cases where the Patent Office had models of those inventions, such models would be placed at the disposal of the committee.

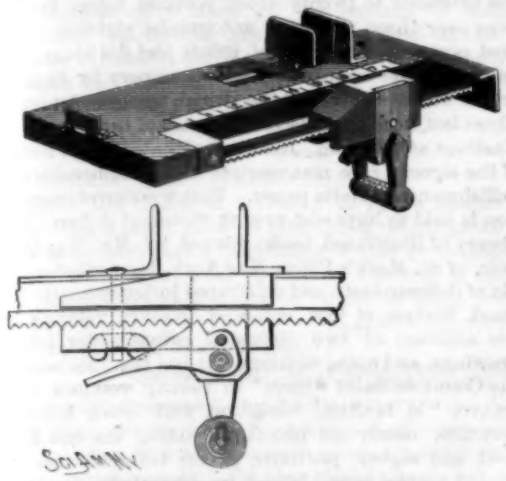
THE Edison Company and the Thomson-Houston Company have coalesced—become welded together—with a view to making more money by a reduction of working expenses and probably by increase of charges. But now comes the news that the Siemens-Halske Company, of Germany, are soon to open an extensive branch of their electrical works in this country. They are able to compete with the Edison-Thomson-Houston combination or any other establishment.



TWELVE-WHEELED FREIGHT LOCOMOTIVE—GREAT NORTHERN RAILWAY.

AN IMPROVED CIGAR MEASURE.

The illustration represents a simple and easily operated device, by means of which cigars may be accurately measured, and which is provided with a locking mechanism that prevents the measure from being tampered with. It has been patented by Mr. José Cruz Fernandez, of Key West, Fla. The picture shows a front perspective view of the measure and a broken longitudinal section taken through the slide block. The base has at one end a hinge, for attachment to the workman's bench, and in a recessed portion of the front edge of the base is a toothed bar, on which slides a block having opposite depending ears, pivoted be-

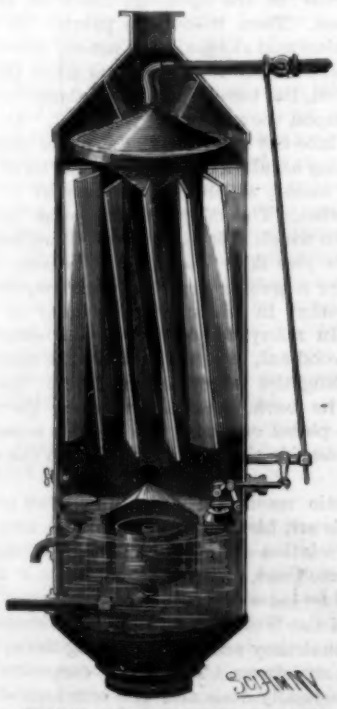


FERNANDEZ'S CIGAR MEASURE.

tween which is a locking lever which has on its upper side a tooth adapted to engage the teeth of the toothed bar, and hold the slide block in a fixed position. The pivoted end of the lever is enlarged so that its lower portion will project beyond the bottom of the slide block, and this portion is perforated to receive the sleeve of a lock. When the lock is applied to the measure, the locking lever is raised into engagement with the toothed bar, and is held by the lock in locked position, so that the slide block cannot be moved. Different forms of locks may be used, or a thumbscrew may be used, if desired, instead of the lock. The base also has a slot, at one side of which is a measure, there being at one end of the slot a fixed jaw, opposite which is a similar jaw having a bottom flange sliding on a slideway in the slot. The flange has a depending screw with a thumbnut, by tightening which the movable jaw will be clamped in place. These jaws on the top of the measure are used to regulate the thickness of the cigar, while the slide block is used to measure their length, it being necessary for the cigars of a certain brand to be of an exact length in order to be merchantable. The measure for the length of the cigars can be conveniently adjusted as desired, it being designed that this shall be done only by the operator who is using the measure, when the measure cannot be changed without the express permission of the operator.

AN IMPROVED FEED WATER HEATER.

The heater shown in the illustration is arranged to heat the feed water by means of the exhaust steam of



BELL'S FEED WATER HEATER.

the engine. It has been patented by Mr. Joseph Bell, of Troutdale, Oregon. The exhaust pipe discharges into the lower part of a casing which is open at the top, and above the point of entrance of the exhaust pipe are spirally arranged plates, so that the exhaust steam in rising receives a rotary motion by coming in contact with the plates. Above the upper ends of the plates is a water distributer, made in the shape of a double cone, a water supply pipe discharging upon the apex of the upper cone. In this pipe is a valve connected by a link with a bell crank lever, the latter being in turn connected by a rod with another bell crank lever carrying a float controlled by the accumulating water in the lower part of the casing, whereby the valve in the water supply pipe is actuated to regulate the amount of water passing into the casing. In the lower part of the casing is a water outlet, having an exterior cylindrical casing open at the bottom and having on its top a cone-shaped cap, while an inside cylinder is closed at the bottom and open at the top, whereby the water in the lower part of the casing passes between the cylinders, and flows over the upper edge of the inner cylinder, finally passing to a pipe leading to the boiler, the scum, oil, and other impurities being thus prevented from passing into the boiler feed pipe. A suitable discharge pipe is arranged at about the height of the water level to draw off impurities, a plate protecting the inner end of this pipe from the water flowing down the spirally arranged plates, and the casing is provided with a gauge cock. The water flowing over the cone and the spirally arranged plates of the casing is thus brought into effective contact with the exhaust steam rising in the casing. The lower part of the casing has suitable doors or man holes for cleaning out sediment whenever necessary.

AN IMPROVED ELEVATED RAILWAY.

The illustration represents a form of elevated railway construction and method of car propulsion designed to permit of conveniently regulating the speed of the car, while the arrangement is such as to reduce friction to a minimum. The improvement has been patented by Mr. Anders Anderson, of Blossburg, Montana. Cross-beams supported at the upper end of posts carry on each outer end a rail, preferably of T-shape, the rails extending from one cross-beam to another, and forming a continuous track of a single rail on each side of the post. On the rails travel grooved pulleys, journaled in hangers pivotally connected at their lower ends with the top of a car, each hanger also having a small pulley engaging the under side of the rail to prevent the car from jumping, and there being safety pulleys to engage the rail if one of the main pulleys breaks. It is designed that the car shall be driven by a motor, preferably actuated by electricity, in each end of the car, each motor rotating propeller wheels. The propeller shafts are so set as to have a slightly lifting tendency upon the car, whereby the friction of the pulleys will be reduced as the car moves forward. The speed is regulated by different adjustments of the fans or wings of the propeller wheels.

Climatic Effects of the New Lake in Southern California.

The famous Salton Lake of Southern California, which was reported drying up, has not decreased to an area of less than 145 square miles since its formation last year. Early freshets in the Colorado and Gila rivers are causing the waters of this lake to rise again, although reports to the contrary have been freely circulated. As a matter of fact, the climate of the country near by this lake has undergone a distinct change since the waters appeared. Fogs, unusually low temperature at Yuma, Walters, Banning, and elsewhere are traceable to the influence of the lake. Cloud bursts at Banning in the dry season and the exceptional coolness of the winter in Southern California are other indications which competent climatologists accept as proof that Salton Lake exerts a climatic influence. Frosts in December injured the orange crop considerably. Some say that 25 per cent of the fruit was lost. No exact statements of the loss are obtainable.

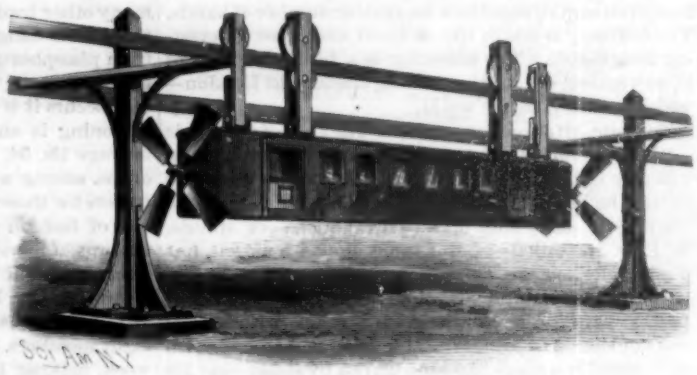
PHOTOGRAPHIC NOTES.

Blue Transparencies.—Beautiful blue transparencies may be produced, according to M. Rossel, in the following simple way: Commercial cyanotype paper is exposed beneath a negative until the image will be very intensely visible, when it is thoroughly washed and placed for fifteen minutes in a ten per cent solution of bichromate of potash. After the print has again been well washed, it is allowed to dry, and then rendered transparent by placing it on a warm glass plate and treating it carefully with paraffine. The print is then framed between two glass plates. The above mentioned cyanotype paper, giving white lines on a blue ground, may be prepared by placing plain photographic paper in a solution of 25 grammes of ammonio-citrate of iron and of 25 grammes of potassium ferricyanide in 150 c. c. of water, and then drying it in the dark.

A New Restrainer.—It is a well known fact that potassium bromide, if added to the developing solution, tends to produce harsh negatives with too dense lights and glass clear shadows. The following mixture, which is recommended in the *Wochenblatt*, is said to give much more harmonious and softer negatives. From 7 to 8 grammes of potassium bromide and from 2 to 3 grammes of potassium iodide are dissolved in 100 c. c. of water, and the solution thus produced is employed in the same way as the ten per cent solution of potassium bromide which is generally used.—*H. E. Gunther, in Photo. News.*

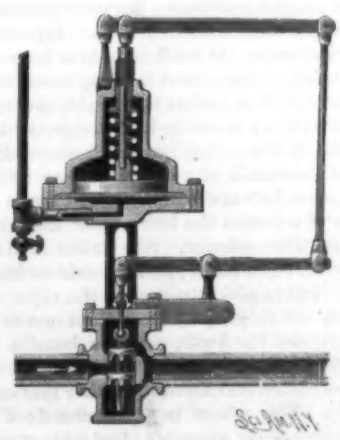
AN AUTOMATIC PUMP REGULATOR.

The regulating device shown in the illustration is applied on the steam inlet pipe of a steam pump, whose discharge controls and actuates the valve in the steam pipe, to increase or diminish the flow of steam in the pipe according to the force of the discharge of the pump. The improvement is the invention of Mr. John Acton, of Nos. 191 and 193 Worth Street, New York City. In the valve body in the steam supply pipe is fitted to slide a piston valve connected at the upper end of its stem by a ball and socket joint with a rod passing through a suitable stuffing box, the upper end of the rod being pivotally connected



ANDERSON'S ELEVATED RAILWAY.

by compound levers with a rod passing through and guided in a screw in the upper end of a casing supported from the valve body. The lower end of this rod engages the hub of a piston in the casing, the under side of the piston resting on a metal diaphragm pressed upon on its under side by the fluid discharged by the working machinery. On the top of the piston is a spring whose upper end bears against a washer engaged by the lower end of the screw through which the rod passes, whereby the tension of the spring may be increased or diminished to give the desired pressur on the piston. In the pipe leading from the discharge of the working machinery to the chamber below the diaphragm is a discharg cock for draining the pipe and the chamber. The flow of th liquid discharged actuates machines or apparatus to be driven, such as elevators, etc., but when the pressure is increased beyond the normal the diaphragm is pressed upward, and, through the motion of the piston. rod, and compound levers, the valve in the steam inlet pipe is partiy or wholly closed. As soon as the pressur of the discharge diminishes, the diaphragm is forced downward by the spring, when the valve in the steam inlet pipe again opens, the slightest change of pressure in the discharge of the working machinery actuating the valve to increase or diminish the supply of steam. This valve is now also extensively used for regulating the



ACTON'S PUMP REGULATOR.

pressure of water in supply pipes from pumping stations, or from elevated reservoirs where the natural pressure would be sufficient to burst the usual pipes, it having been thus employed in one instance to give 30 pounds pressure in a service pipe and 150 pounds pressure in a pipe to run elevators, where the original pressure was over 700 pounds. These regulators are likewise used in all the electric light stations in New York City to control the pressure from the boiler to the engines.

How Matches are Made.

In match making one does not know which to admire most, the neatness of the machinery or the dexterity of the match girls. Both must be seen to be appreciated, for no description can do them justice. Nothing could be further from the truth than the notions perpetually disseminated about match makers; who are supposed to be a set of diseased and pallid slaves, toiling wearily from dawn to midnight, and turning out incredibly large numbers of matches for incredibly small sums of money. They do turn out incredibly large numbers of matches, but, owing to the use of machinery, the work is of the lightest, and so swift that the numerical statement of the "tale of bricks" is altogether misleading. During the government inquiry into sweating, the members of the committee were startled at the low price paid to needlewomen for making buttonholes; but when they had one before them and saw how many buttonholes she could make in ten minutes, the figures assumed a different aspect. And so it is with match making in a first-class modern factory. To fill three gross of boxes for 2¾d. sounds very hard; but a steady worker can manage thirty-six gross in a ten hours' day and earn 2s. 9d. And though the introduction of machinery has lightened labor and enormously increased the output, at the same time it has given employment to a far greater number of hands. The industry is one of the prettiest and most interesting imaginable. The following is a bird's eye view of it, as carried on in the leading factory in London—which is to say, in the world.

To begin with wooden matches. They are of two kinds—"lucifers" and "safeties;" but as the process of manufacture is almost identical, we will confine ourselves to the lucifers. The wood, Canadian pine, comes to the factory ready split up into little sticks—or splints, as they are called—of the same size as a match, but double the length. The first process consists in preparing these splints for dipping in the phosphorus paste. Imagine a very large airy room, with several rows of stands or tables running from end to end. On each stand is a small machine driven by steam—say 250 machines in all—and to every two machines a match girl. All she has to do is to feed the two machines alternately, first one and then the other. She takes a handful of splints and puts them into the feeder exactly as you put coffee into a coffee mill. They pass through and are bound together in a most ingenious way by a strap, so as to form a sort of wheel or drum about the size and shape of a large flat cheese. The splints, it must be understood, lie across, so that their projecting ends represent the sides of the drum, and each one is separate. It only takes a few minutes to put together 5,000 or 6,000 in this way, and as soon as they are ready the machine stops automatically. The whole bundle is then removed and carried to the dipping place. Here the phosphorus composition is ladled out of a vessel and spread on a slab. By simply laying the wheel down flat on the slab every single splint of which it is made up receives a dab of phosphorus at one end, and by turning it over the other end is similarly treated. This work is done entirely by men, and takes place in a shed with an open roof, so as to allow very free ventilation. Each splint has now been converted into a double match with a head at both ends; we have, in fact, got a bundle containing 10,000 matches. For clearness' sake some details have been omitted; but it will be seen that the preparation of 10,000 matches only takes a few minutes all told.

After dipping, the bundle is dried in a hot chamber and then unrolled, which is done very prettily by another machine. The end of the strap binding the lot together is caught and drawn between two rollers, and as it goes the wheel unwinds and the matches come off in a perfect shower. It is all done in a moment. One more operation remains, and it is the most interesting of all. The matches, as has been said, are so far double. They have to be cut in half and packed in boxes. This is done by the match girls with astounding rapidity. Each one stands at a table; on her left are a lot of empty boxes half open, on her right a pile of double matches, and between the two a lever knife like those used for cutting tobacco. She takes a handful of matches in her right hand; and the extraordinary thing is that she always picks up exactly the right number to fill a box, never varying by more than one or two. She puts them under the knife, cuts the bundle into two, and fills two boxes with them in the twinkling of an eye; the swiftness and accuracy of her motions are indescribable. The whole performance does not take more than five or six seconds. And it is not one woman only. Here are rows upon rows of them throughout a vast building, all doing the same thing with equal or almost equal proficiency. In another department an instance of still greater dexterity may be observed. Every one knows the wrappers of transparent paper in which the safety match boxes are commonly enveloped, and a look at them will show that they are folded several times in different directions. This folding is done by women like a flash of lightning or a conjuror's card tricks. The eye fails to follow the movement of their hands. There is only one thing more nimble than a woman's hand, and that is her tongue.

We may take this opportunity to say a word about the match girls. They are all genuine East-enders of the most pronounced type. Not one but wears the regulation fringe plastered down over the forehead, and the knowing look of the Mile End Road. But they are by no means the stunted, sickly creatures described by our sham humanitarians. The majority are well grown, sturdy young women, fully able to hold their own in the battle of life, and doing it bravely. All are neat and tidy, not a few good-looking; and, taking them all round, a blither, jollier set of workpeople cannot easily be found. For health and spirits they will compare favorably with the female clerks in the great telegraph gallery at St. Martin's le Grand. The one scene recalls the other, both in the number of women collected under one roof and the nimble-fingered character of their work. But if the telegraphists carry it off for refinement, which cannot be denied, the match girls are a good deal more cheerful. Snatches of song and laughter rise perpetually from among them; and, indeed, they are very contented. "If only these agitators would let us alone, we are right enough. We can earn a jolly sight more in the match factory than anywhere else, and we don't want any one a-coming and interfering."

As for the healthiness of the occupation, it is like many other trades: if proper precautions are preserved, there is no danger. Some years ago necrosis of the jaw from phosphorus poisoning was not uncommon among match makers; but it is now extremely rare, and if a case occurs it is due to want of cleanliness, just as lead poisoning is among plumbers and painters. Wages average 12s. 3d. or 12s. 4d. per week among girls, 14s. or 15s. among women. Match girls are the chief customers for those enormous plumed hats which never go out of fashion in the East End; and they spend an amount of money on them which would surprise a good many ladies at the other end of the town. It is done systematically by means of "feather clubs." Every girl—more or less—belongs to a club, which consists of eight members. The subscription is half a crown per week, making £1 for the whole club. This sum buys an ostrich feather; so that every week a feather is bought by the club, and the members take it in turn.

We have no space left for the wax matches and must leave them for the present, merely remarking that the work is even lighter than the other and done by younger hands. The question of foreign matches should be mentioned. They come from Sweden, Norway, Holland, and Belgium; and they are principally used by the working classes on account of their apparent cheapness. Among the poor they have a very extensive sale. Messrs. Bryant & May reckon that if no foreign matches were used in London, employment might be given to 2,000 more English hands. "This 'ere foreign competition," in face of which "the pore workingman don't get no chanst," is encouraged by no one so much as the poor workingman himself.—*St. James's Budget.*

[FOR THE SCIENTIFIC AMERICAN.]

Privately Illustrated Books.

To many book collectors, and to the large and multifarious groups of readers who gather small and miscellaneous lots of books into so-called libraries, it will doubtless prove a surprise and a revelation to learn that, among the various forms of devotion to books, there exists that of the private illustrator—that there is a class of bibliomaniacs who buy books for the express purpose of "inlaying" them with pictures, hunting out every possible pictorial hint or possibility that they contain, and enriching them with prints and etchings of great beauty and rarity. This mysterious and fascinating field of book worship has received lately at the hands of Mr. Daniel M. Treadwell very painstaking and elaborate study. Mr. Treadwell, himself a devotee and proficient in this elegant pastime, has prepared and published a monograph on this subject, wherein he recounts the marvelous exploits of rich and cultivated collectors, and offers a meed of unaffected praise to those who, less rich but equally enthusiastic, have created masterpieces of the illustrator's art.

The aim involved in this accomplishment is to insert in some work, lending itself naturally to illustration, appropriate prints "which do not belong to the book, but which are pertinent to the subject treated." For instance, Mr. Treadwell's first venture was in Giraud's "Birds of Long Island," a book of some standing, and which naturally suggested a wide range of picturesque illustration. Mr. Treadwell does not, however, recall this early experiment with any sense of satisfaction, as it led him, in his search for material, to destroy a handsome quarto volume of the "Natural-History of New York." One of his later and greater efforts was the illustration of Dr. Stiles' "History of the City of Brooklyn." In this interesting and suggestive effort he has added to the original work about two thousand three hundred pages, embracing portraits and prints of old historical landmarks, together with maps, manuscript additions, water colors and letters. Of course, any amount of research and costly and lavish enrichment may be expended upon a book. The work itself may be very suggestive, and if the illustrator is fastidious, he will hunt out the most striking, beautiful and rare forms of illustration. For instance, Mr. Daly, the distinguished dramatic author and manager, has illustrated Macklin's Bible with thousands of illustrations, many of them originals, extending the book to thirty volumes folio. Nothing could be more superb. The work when finished is often inclosed in the most sumptuous bindings, which, with the cost of simply "inlaying" the illustrations, forms itself a respectable outlay. Take again the "Biographies of the Signers of the Declaration of Independence," by John Sanderson. This book, illustrated by Dr. Thomas A. Emmet, was extended to twenty thick volumes folio. It contains over three thousand autographs, eighteen hundred portraits, hundreds of prints and drawings, and fourteen water colors of American scenery by English artists who accompanied the British troops to America. These last were purchased at the sale of the Marquis of Hastings at $50 each. Here are signatures and letters of the signers, rare manuscripts and innumerable embellishments on India paper. This wonderful compilation is said to have cost twenty thousand dollars. The library of illustrated books owned by Mr. Hamilton Cole, of St. Mark's Place, New York, is another example of delicate taste and cultivated judgment. He has Izaak Walton, of 1836, enlarged to seven volumes, by the addition of two thousand prints, water colors, drawings, and many etchings. He has the "Memoirs of the Count de Saint Simon" in twenty volumes, royal octavo, "in faultless condition, with seven hundred portraits, nearly all proofs, including the one hundred and eighty portraits, proofs before letters, intended for the book, bound by Chambolle Dunn, in polished levant, with inside borders and watered silk linings." But perhaps the most gigantic and amazing example of this generous and refined industry is Mr. Stauffer's illustration of Wescott's "History of Philadelphia." Mr. Stauffer has added 8,000 illustrations, and expanded a book of some 2,500 pages to fifty volumes. Mr. Treadwell's estimate of the outlay and present worth of this extraordinary effort is $80,000, an estimate which, we believe, the distinguished illustrator considers altogether too high. Mr. J. H. V. Arnold, of this city, has extended Ireland's "Records of the New York Stage" to twenty volumes folio, by the unrivaled addition of five thousand five hundred illustrations, and has expended over $9,000 upon his yet unfinished labors. It would be impossible in a short space to review the exquisite results of this form of bibliolatry, and the large work of Mr. Treadwell's is itself a fitting tribute to the zeal and enterprise of American illustrators. Few of our general readers and collectors are aware of the glorious and luxurious gems of the illustrator's art to be found in the private libraries of this metropolis, and Mr. Treadwell's monograph will perhaps stimulate and widen this pleasant form of literary diversion.

One word as to "inlaying," itself a delicate and skilled phase in the illustrator's craft, may be added. The master artists in this art, according to Mr. Treadwell, are Messrs. Trent, Toedteberg and Lawrence, of Brooklyn. The process of "inlaying" is as follows: First comes the selection of paper of the proper quality and the size to which the book is to be extended. This done, the text of the book is all inlaid, page after page being inserted in the openings made in the paper sheets chosen. Then follow the prints. As these are of various sizes and shapes, they are cut down neatly, removing all extraneous margin, and have their outer edges beveled, the bevel extending about one-quarter of an inch upon the margin of the print. An opening is then cut into the sheet, of the size and shape of the print, making an allowance for a quarter of an inch lap on the inside, which is also beveled to conform with the print. The edges of the print and of the opening into which it is to be received are fastened together with rice flour paste. The sheets are then placed under a gentle pressure until required to be bound together in their proper order in separate volumes. In many cases, where print occurs on the back of a wood cut, etc., which must be removed, the paper holding the engraving, etc., and the printed matter on its back, is split, by pasting the sheet between two pieces of stuff, which, when separated, removes on one side the printed matter, on the other the woodcut.

The artistic resources of the illustrator are drawn upon in this art, his historical knowledge and his technical appreciation of the excellence of engravings, woodcuts, etchings, and photographs. L. P. G.

SEVEN of the World's Fair buildings are now so far advanced that they are fast assuming the appearance of finished structures. The rough carpentry work on them is practically done and the ornamental and finishing work is in progress. These buildings are the Woman's, Horticulture, Transportation, Mines, Administration, Forestry, and Fisheries. Five more—the Government, Fine Arts, Agriculture, Dairy and Illinois State—are erected to the roof lines. The Electricity, Manufactures and Machinery buildings are being advanced rapidly.

Correspondence.

The San Diego Shake-up.

To the Editor of the Scientific American:

This city has been treated to a series of earthquake shocks so frequently of late that the condition is regarded as almost chronic. Near midnight February 23, the first shock, lasting 70 seconds, cracked walls of buildings, and people were thoroughly frightened. Six or eight more shocks were felt that night, the second shock occurring just thirty minutes after the first one. Nearly every night since there have been one to three slight shocks. So severe was the first shock that the undulations gave many all the feelings of seasick patients. Along the Pacific coast, from Mexico to British Columbia, slight shocks were felt, especially in Oregon and Washington. B.

San Diego, Cal., March 2, 1892.

Bear Grass.

To the Editor of the Scientific American:

I take the liberty of inclosing to you a sample of fiber from a single blade of bear grass, which grows in quantities here and is susceptible of easy propagation. Please write what your opinion of the fiber is, and if its cultivation and preparation might be made profitable. ARTHUR SHERRY.

Fayette, Miss., March 9, 1892.

Reply by Prof. C. V. Riley.

The bear grass mentioned by Mr. Sherry is the common *Yucca filamentosa*, grown in the North as an ornamental plant under the common name of Spanish bayonet or Adam's needle. Its fiber is fairly good, but not as strong as certain other fibers. It has not been grown commercially, and is not equal to ramie or sisal.

Occupation for Old Age.

To the Editor of the Scientific American:

In answer to your correspondent, John W. Blinn, "Occupation for Old People," I would suggest, if possible, get twenty acres of land and learn to cultivate the soil. I should rather have twenty-five acres of land in central Illinois to raise a family than to be the best mechanic in Chicago.

Working on land where nature blooms and blossoms should be a pleasant occupation to an old man who has not lost his physical powers.

All this talk about the poor farmer, his hardships, discontent, and unhappiness has filled the public mind with the thought, "Anything but a farmer's life."

Let a man walk around New York and see families living in one room, seeing the children play on the stone sidewalk, half naked, their bare feet never touching a blade of green grass. He must feel that a child born on a farm is blessed in the start.

My advice to a mechanic: Save a portion of his wages, so when old age drew near he could own a small farm and be an independent man.

SAMUEL W. ALLERTON.

Chicago, March 7, 1892.

Sugar in Mortar.

To the Editor of the Scientific American:

Having devoted nearly thirty years of my life in all quarters of the world to the study of limes, cements, asphalts, "natural and artificial," I desire to contribute a few words on the subject of "sugar in mortar," referred to by your correspondents. Saccharine mortar is not new, having for many years been used in the interior of India. It is there composed of lime "carbonate" and clay brought to a powder, well burned, and mixed with a sand of a silica character. For mortar it is tempered with a mixture of water, to which is added molasses, with the object of preventing a too rapid setting of the aggregates in that torrid climate, as retarding the drying gives much greater ultimate strength. For rendering of walls and ceilings they calcine shells and limestone, reducing same to powder analogous to our cements. This is mixed with water and a sap of the character of sugar, which is extracted from the palm, and a proportion of short jute or tow. The cohesion of this material is very great, and it becomes sufficiently hard to take polish.

J. FOTTRELL,

Inventor and patentee of hygienic concrete.

New York, March 18, 1892.

Red Bud and Cut-worms.

To the Editor of the Scientific American:

I have on my place what is called red bud or leather wood, a bush about four and one-half inches down and growing in bunches. Could you give me any receipt for killing that shrub, as it is so tough an ax has no effect on it? And a receipt for killing or ridding cut-worms from the garden ground and not injure the young plants, etc. A. C. FREELAND.

Anderson, Shasta Co., Cal.

Reply by Prof. C. V. Riley.

The California red bud of which Mr. Freeland writes is congeneric with our Eastern red bed or Judas tree, and is known to botanists as *Cercis occidentalis*, Torr. I am afraid that Mr. Freeland has exaggerated a little in saying that it cannot be cut with an ax, although I am aware that it is very tough. I regret that I cannot suggest any way of ridding his land of this plant except by systematically cutting it out.

His question as to ridding garden ground of cut-worms is more easily answered. The plan which I originally proposed in 1882, and which has become known as the poison trap or bait system, has come into extensive use and is very successful. It consists in cutting grass, weeds, or any green growth in the early spring, doing it up into loose bundles, and thoroughly spraying with Paris green. These bundles are then scattered at regular intervals through the infested fields. This should be done in early spring, before the crop is set out or has come up. The cut-worms will feed upon the poisoned vegetation and will be destroyed in great numbers.

A Volcano Near the Gulf of California.

To the Editor of the Scientific American:

Prospectors recently returning from the southeastern part of San Diego County report a distant illumination of the heavens by night and an inky black cloud by day, seemingly in the vicinity of the confluence of the Colorado River and the Gulf of California, where there is an unfrequented country, wherein the Cocopah Mountains are said to present many phenomena, among them being mud springs and hot sulphur streams. These reports come from several sources, and indicate the existence of an active volcano. As the earthquake shocks in the latter part of February were most severe in the direction of the country where the volcano is supposed to exist, it is possible that the subterranean disturbance found vent there. A rancher in the Campo country says he was in the desert many miles east of Campo looking after cattle about the time of the earthquake. His horse stumbled on the edge of a crevice in the earth, some 18 inches wide. The rancher says the crevice was recently formed, evidently caused by the earthquake, and apparently bottomless. In many places the surface of the earth was broken. In a deep canyon through steep walls of rock, where the old Yuma stage road passes to the desert, the road was completely blocked by masses of rock which had been rolled down on to it. M. Y. B.

San Diego, Cal., March 12, 1892.

A Florida Phenomenon.

To the Editor of the Scientific American:

I arrived here about six weeks ago and have since visited on several occasions the most rare and peculiar phenomenon.

There is a prairie within three miles of this place that is fifteen miles in length, with an average width of five miles. Twelve years ago it filled with water to a depth of 8 to 20 feet, varying according to high and low ground.

This water stood undisturbed for this twelve years space of time until last August, when it suddenly disappeared entirely in two days, leaving two small holes of water, not exceeding ten acres area, and a few ponds here and there of sizes too insignificant to mention.

The soil here is principally sand underlaid at varying depths by very soft sand and limestone. There is some flint at great depths.

Near the location where the water is thought to have made its exit the country is literally dotted with deep holes, varying from 10 to 40 feet in depth; the sides are steep and precipitous. These holes are commonly known here as sinks, and are sometimes formed in a single night.

For days after the escape of the water from this prairie the stench of putrid fish was intolerable.

The farmers hauled them off in wagons for fertilizers.

On the prairie anywhere turtle shells can be seen, with here and there the skeleton of some unfortunate alligator that has been killed by some marksman or by some stray hunter. HARRY BOMFORD.

Gainesville, Fla., March 8, 1892.

Californian Agriculture.

To the Editor of the Scientific American:

In the SCIENTIFIC AMERICAN for December 26, 1891, Mr. J. E. Emerson says that in 1853 agriculture in California was but in swaddling clothes. This babe has grown amazingly, and is even now a prodigy for which maturity promises much. In 1877–78 the wheat acreage in this State was 1,800,000 acres and the yield 16,000,000 centals. In 1890–91 the acreage had increased to 3,300,000 acres, yielding 30,000,000 centals. In 1878 new wheat at tide water sold for $1.70, and in 1891 for $2.02½. More than one-fourth of the entire barley crop of the Union is raised in California, the national product being over 16,000,000 bushels. The corn crop of this State is 5,000,000 bushels. Beans are now a California specialty. She leads the world in producing lima beans. Last year 50,000 tons were harvested, and solid train loads of beans were sent East for consumption in Boston and elsewhere. The ground is so dry that poles are not needed to keep bean vines dry. This saves 50 per cent in the cost of production, compared with the cost elsewhere. Nine-tenths of the bean crop is grown without irrigation.

The first attempt to make beet sugar in this State was at Alvarado, in 1869. In 1888 a second beet sugar factory was established at Watsonville, Santa Cruz County, and in 1891 a large establishment opened at Chino, San Bernardino County. The United States government has paid these concerns a bounty of $162,000 for one year's output. The saccharine percentage of California beets is 16 to 17 per cent, while the best European beets average 12 to 14 per cent. As to the possibilities of sugar beet culture in California, Professor Hilgard says there are 190,000 acres in Alameda and Santa Clara counties well adapted to this culture, each acre of which can readily produce 4,000 pounds of refined sugar. This would give a possible production in two counties alone of 760,000,000 pounds. The experience at Chino proves that there is a large area in the extreme southern part of the State which is well adapted to beet culture. California is the largest contributor to the 62,000,000 pound honey supply of this country. From one hive here 600 pounds of honey was taken in a single season. Records of 300 or 400 pounds are not uncommon. Experiments are being made in growing tobacco, cotton, ramie, flax, silk, and hops. Those who have raised it say that California tobacco is equal to any. The production of ramie and the manufacture of fiber and fabrics therefrom bids fair to become an important industry on this coast.

San Diego, California. M. Y. BEACH.

Leaf-cutting Ants.

To the Editor of the Scientific American:

Would you be kind enough to give me a remedy against cutting ants? We are troubled a great deal by them. They get into our gardens, vineyards, and orchards and strip all plants of their leaves. There are a great many of them here, and want to know what is the best way to get rid of them.

JNO. G. KENEDY,
Alice, Nueces Co., Texas.

Corpus Christi, Texas, Feb. 29, 1892.

Reply by Dr. C. V. Riley, Entomologist, Department of Agriculture.

To the Editor of the Scientific American:

In reply to the letter of your correspondent, Mr. John G. Kenedy, I would state that no systematic investigation or experiments have hitherto been made as to the best of the different remedies against the leaf-cutting ant (*Oecodoma fervens*), and in view of the serious damage constantly caused by these formidable insects the entomologists of the agricultural experiment stations in the Southwest have a good opportunity of experimenting on the subject.

The most important point in the warfare against these ants is to discover their nests, which are large subterranean structures, extending, in powerful colonies, from 10 to 15 feet below the surface of the ground and having several entrance holes. From the latter the ants move after dark along well-defined pathways to the orchard or garden they intend to raid. If the country be open, it is not a difficult matter to follow up the moving columns of the ants with the aid of a lantern, and thus to discover the nest, although the latter is not rarely several hundred feet distant from the tree or vine which the ants defoliate. If, however, the nest is in dense shrubbery, it is usually extremely difficult to locate it. The nest once discovered, its inhabitants can be exterminated by pouring bisulphide of carbon into the entrance holes, say at least one pint in each hole if the colony is large. Should there be no bisulphide at hand, the application of cyanide of potassium dissolved in water may be tried. Pouring kerosene or boiling water into the holes, or building large fires over the nest, are probably less efficacious remedies, but will, no doubt, help to lessen the numbers of the ants, or at least to discourage them for a time from further raids.

During my stay in Texas, in 1879, I witnessed a successful method of protecting a vineyard from the attacks of the leaf-cutting ant. The vineyard of Mr. Kessler, near Columbus, is surrounded by extensive and very dense shrubbery, which was full of the ants. At first these did great injury, but owing to the nature of the ground their nests could not be discovered. Mr. Kessler finally fought them in the following way: Armed with a lantern and a large bottle containing a solution of cyanide of potassium in water, he made every evening the circuit of his vineyard. The columns of ants moving from the woods toward the vines could thus readily be found, and across each of their pathways a strip of about 3 inches in width and 5 inches in length was moistened with the cyanide solution. The ants never went around the poisoned spot, but always attempted to cross it, when they were at once killed by the poisonous fumes. This performance was repeated night after night, except in very rainy weather, and the vineyard effectually protected. C. V. RILEY.

THE city authorities of Chicago have granted permits to the Chicago City Railway Company to use overhead trolley wires. This will enable the company to provide abundant facilities for the transportation of visitors to and from the great exhibition grounds.

THE HACKENSACK WATER COMPANY.

(*Continued from first page.*)

article in this paper* we gave a somewhat extended account of this highly efficient, direct-acting pumping engine, one which, by its performances, has fairly established an era in the history of pumping machinery. The cut which we present shows the general construction. It is a compound engine, with equalizing cylinders on the outer end of the pump rod. This construction is such as to maintain an almost even water pressure line without the necessity of any air reservoir, and also allows the benefit of high expansion of steam to be realized. Its general dimensions are as follows: High pressure cylinders, 30 inches; low pressure cylinders, 60 inches; diameter pump rams, 26 inches; length of stroke, 4 feet.

The New Milford pumps can force water into the main at a head equivalent to 300 feet above tide water. The main reservoir at Weehawken is 180 feet above tide water. In daily operation the back pressure at New Milford is never less than equivalent to 200 and sometimes to 250 feet above tide water. The total pumping capacity is 22,000,000 of gallons per day, and the two force mains can pass 12,000,000 of gallons per day.

We illustrate the delivery into the main reservoir at Weehawken, the water entering through upturned pipes. It was found some years ago that the water was liable to be contaminated by organic matter and a growth of algæ. Analyses indicated a deficiency of oxygen in the water. The whole difficulty was due to vegetable matter, as there is no sewage pollution in the drainage area. To cope with this trouble aeration under pressure was adopted. Air compressors were set up at New Milford, and air was forced into the water in the mains at a pressure of 125 pounds to the square inch. The main reservoir at Weehawken is also supplied with aeration pipes, which are shown in the drawing, by which the air can be introduced into the reservoir whenever required.† The difficulty was at once disposed of, and the water is now of a high degree of purity.

At Weehawken is also situated the high pressure service works. This includes a pumping station with two two million low duty and one four million high duty Worthington pumping engines, supplied with steam from six boilers arranged in two batteries. The high pressure tower is built of brick, is 25 feet square, 150 feet high, and has a tank in its top of 150,000 gallons capacity. One 10 inch pipe connects the tank with the mains, the tank acting merely as a static pressure equalizer, not as a reservoir.

Our thanks are due to Mr. Chas. B. Brush, chief engineer of the Hackensack Water Co., for courtesies extended to us in connection with this article.

FOR mending a plaster cast, mix scraped celluloid chips with chloroform.—*E. H. North, Items.*

* See SCIENTIFIC AMERICAN, Vol. 66, page 194.

† See SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 541, 569.

The Pennsylvania Railroad Shops.

A visit to the Pennsylvania Railroad shops at Altoona will repay one who may wish to see industry at home, or witness in operation the most improved tools and methods for doing the work of repair of old equipment and the building of new.

But when it is said that these shops are strung along the tracks for about two miles, it will be understood that a visit of one day is insufficient for any purpose except to get a general idea of the vast establishment. Several such visits or several days would be needed before one could begin to take in details for what they are worth. One of the first things to attract my attention was the clean condition of the windows of the different shops and roundhouses. Here, evidently, light is regarded as having a money value, for I noticed men engaged in cleaning windows that in some shops would be considered already unnecessarily clean. The importance attached here to an abundance of light for the workmen was impressed upon me again by hearing a criticism made upon a splendidly equipped shop to the effect that the traveling cranes did not permit of the arc lights used for illuminating after dark being hung low enough to give the workmen sufficient light.

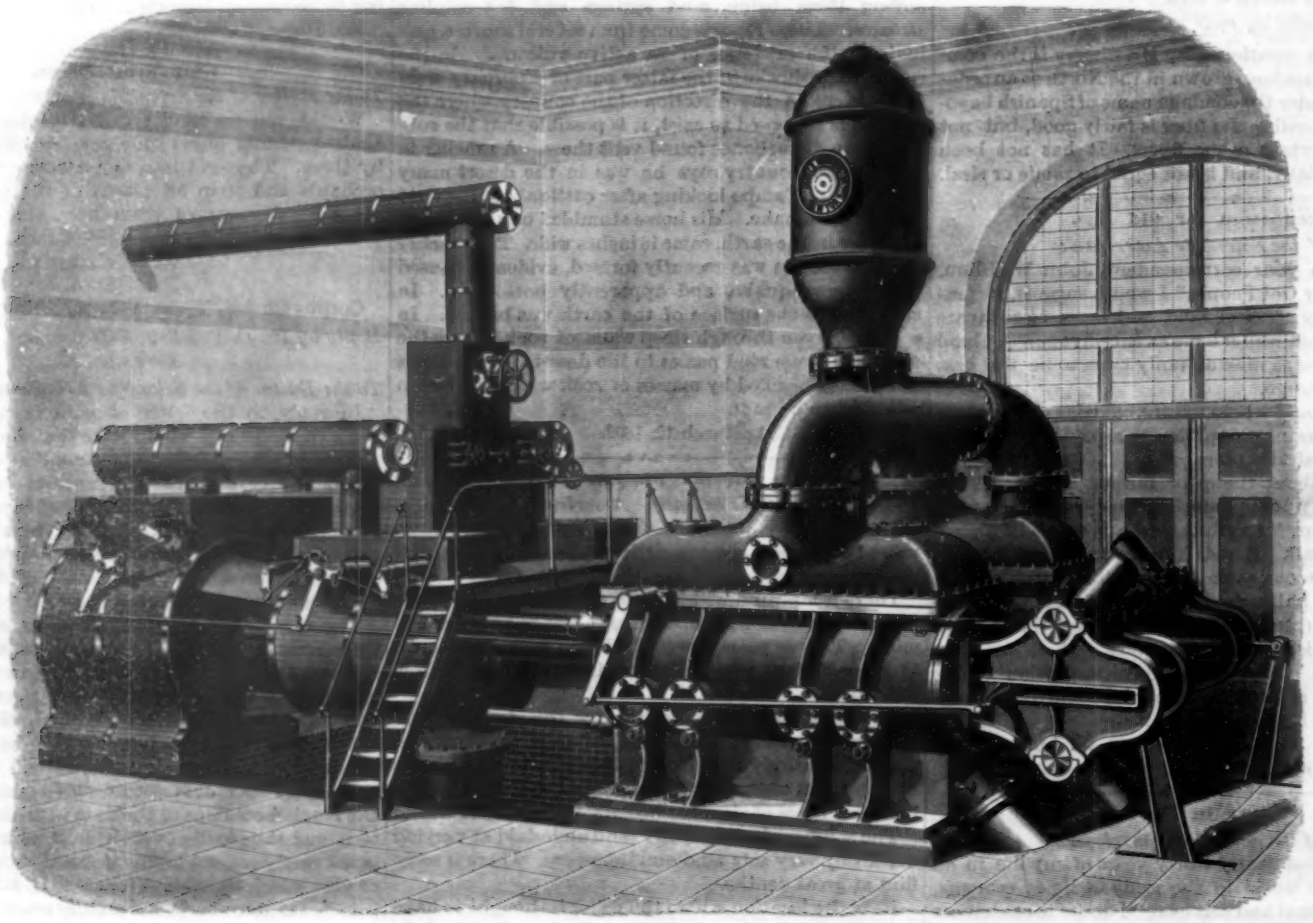
Cleanliness and order prevailed generally throughout the many departments of the works. The pattern store room, though crammed with thousands of patterns and much in need of space apparently, was in perfect order, with every pattern plainly numbered and catalogued as carefully as books in a well ordered library.

The laboratory, under Dr. C. B. Dudley's care, is well equipped with appliances for carrying on the wide range of tests that are necessary to protect the interests of the company in purchases and in solving many problems that have a direct bearing on the economy of moving traffic. One of the most recent branches of inquiry this department has undertaken is an investigation into the merits of the Holmes "lubricant bearing." This is a composition of graphite reduced to a fine powder, freed of all gritty matter, mixed with wood pulp and moulded to any desired shape. The Committee on Science and the Arts of the Franklin Institute recently recommended the inventor of this composition to receive the Institute's highest award, the Elliott Cresson gold medal, for the perfecting of a bearing "which possesses the requisite hardness to withstand the usual pressures, and also to offer a surface that, without the aid of oil or other lubricants, will reduce friction to a minimum." It has stood pressures of 50 pounds per square inch, and it is thought at Altoona that it may possibly prove serviceable for lining guides, crossheads, etc.

The new Juniata shops at Altoona, devoted to building locomotives, and under the charge of Master Mechanic H. D. Gordon, deserve a day's stay from the visitor instead of the half hour I was able to give. Here everything, from the automatic stokers in the furnace room to the traveling electric cranes that traverse the shops from end to end, is supplied and arranged to facilitate the building of locomotives; and everything, from the clean windows by day and the arc lights by night to the handsome lavatories, with double rows of porcelain-lined basins and clean brass cocks giving warm and cold water, is provided for the comfort of the workmen. I happened into the boiler shop just as a large boiler was ready to be put upon trucks to be taken to the erecting shop, where the frames and cylinders of the engine were in position to receive it. The traveling crane was moved rapidly into position for lifting the boiler, and within two minutes after the arrangements were complete for lifting it, the boiler had been raised, lowered upon the trucks, and was on its way to the erecting shop. It had about 15,000 feet of track to go over and two switches to make, yet, within twenty minutes of the time it had been picked up in the boiler shop, I saw it lowered to its place between the frames of the locomotive whose mainspring of power it was to be.

My interest in this engine did not stop here. The boiler was placed between the frames the last thing Monday evening, and the engine was sent to the roundhouse for service the next Monday morning. The actual number of working hours the engine was in the erecting shop was sixty-one. There were several annoying delays on this particular engine, that consumed several more hours than usual. The average time of one of these engines in the erecting shop is fifty-nine hours.

Both boiler and erecting shops have electric traveling cranes that get about with great celerity and that appear capable of the nicest adjustment in their movements. There are two of these in the erecting shop and one in the boiler shop. Those in the erecting shop are of 35 tons capacity each, and were made by the Morgan Engineering Company. The capacity of the one in the boiler shop is 15 tons, and was made by William Sellers & Co.—*Nat. Car. Builder.*



WORTHINGTON HIGH DUTY PUMPING ENGINE.

Arsenic in Wall Paper.

The report of the State Board of Health relative to arsenic in wall paper was submitted to the Massachusetts Legislature on the 10th ult. It was found that, of 1,018 samples collected in twenty cities and towns, 389 contained arsenic in appreciable quantities. About 3 per cent of the papers manufactured to-day contain more than one-tenth of a grain of arsenic per square yard, against 30 per cent, approximately, ten years ago. Between 60 and 70 per cent of the papers sold are free from arsenic, while about 6 per cent contain more than one-twentieth of a grain per square yard.

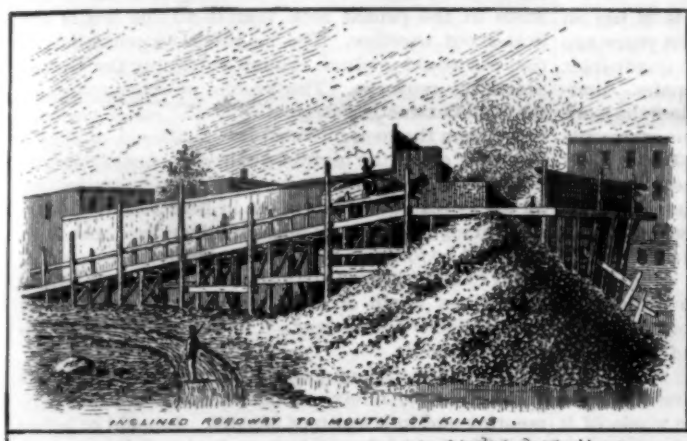
American Cars in England.

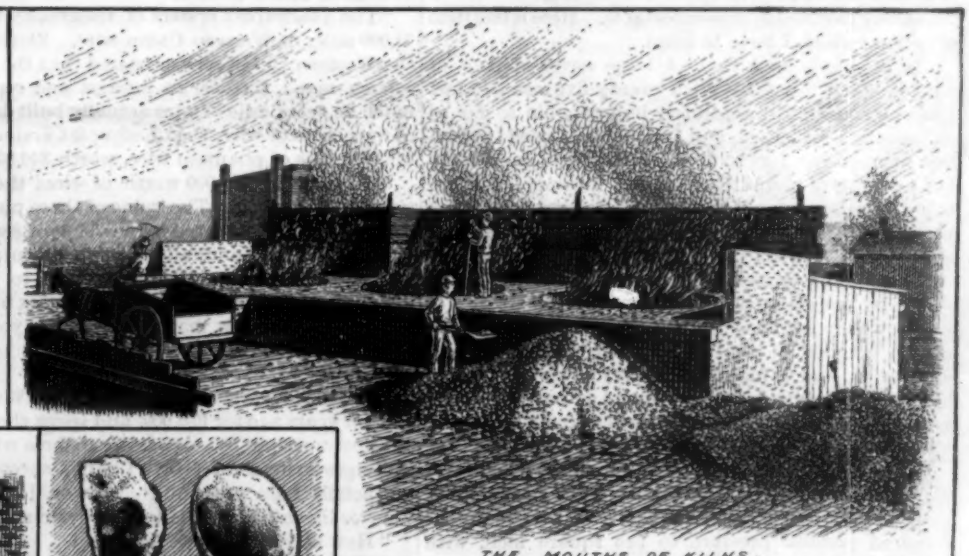
The luxury of American parlor cars has been introduced lately in England by the Southeastern Railway Company. A train having four parlor cars started from Charing Cross and traveled to Hastings and back, attracting much attention. The cars were made by the Gilbert Manufacturing Company, Troy, N. Y.

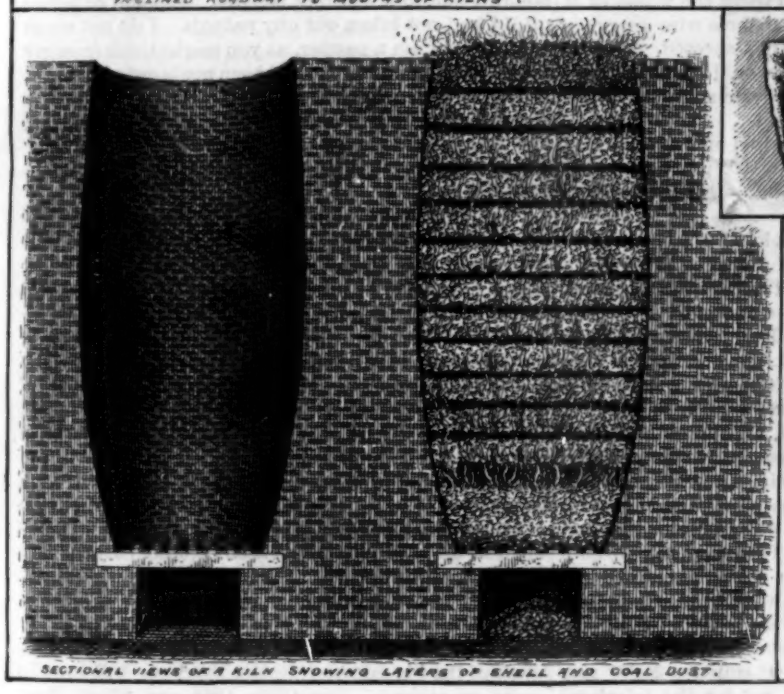
A DRAW SHELL LIME KILN.

The consumption of oysters and clams in the city of New York is enormous. The waters of the various bays and inlets in the vicinity of the great city are noted for the superior excellence of these bivalves, for which there is here at all times a ready market. The mere labor of removing the empty shells and their subsequent utilization forms a large industry, in which hundreds of people with horses and carts are employed. This industry embraces the operation of a number of lime kilns, in which the refuse shells are reduced to that useful product, quicklime, which commands a ready sale. Our present illustrations are taken from the plant of Murray & Byrne, Jersey City, N. J., opposite New York. The kilns are egg shaped and made of brick, 3 to 4 feet in thickness, being lined inside with fire brick. The kilns are 35 feet in depth, 10 feet in diameter at the top, down to about 6 feet at the bottom. Each kiln when filled contains about 14 cart loads of shells. The kilns are first started with coke fires. A layer of shells is first placed on the coke, and then a layer of coal dust. This is repeated until the kilns are full. The coke fire at the bottom causes the first layer of shells to become red hot. This in turn sets fire to the layer of coal dust and up and through the next layer of shells, the flames gradually creeping up through the different layers until they reach the top. The kilns are then drawn off. This is done by pulling out the iron bars or grate at the bottom or eye of kiln. As soon as the bars are drawn out the burnt shells drop down, if not obstructed by clinkers, and carried away to be slaked. This is done by pouring a little water on to the burnt shells, which in a few moments turn into powdered lime. Large clinkers sometimes prevent the shells from lowering evenly. This is remedied by passing a long iron bar down along the sides from the top of the kiln. As soon as the burnt shells are lowered, bringing the fire to the eye of the kiln, it is again filled up with layers of shells and coal dust, going over the same process as before. These fires are not allowed to go out only in case of repair. It requires about 70 hours to burn one kiln of shells. This lime is used mostly in purifying gas. It is also used in soaps and for fertilizing purposes. The draw kilns are a great improvement over the old way of letting out the fires every time they were drawn. The new shape allows the kilns to be drawn and refilled with the fires constantly burning. The shells are carted up to the top of kilns by means of an inclined roadway running along the side of the works. The shells are dumped on the platform and shoveled into the kilns. The cost of this plant is about $3,000.

The carts used are larger than the common cart, and hold about 35 bushels. Each kiln holds between 550 to 600 bushels of shells. A cart load of shells weighs about 2,240 lb. Each full kiln will pan out about 600 bushels of slaked lime, or about 210 barrels. The shells come mostly from the markets of New YorkCity. They are collected by carts. In some places they get their shells for nothing, and in others they pay a trifling sum yearly. The lime sells at 8c. per bushel slaked and 15c. unslaked. The purchasers of this lime are gas companies, soap manufacturers, and farmers. There are about seven firms in New York City and Brooklyn, and they turn out from 12,000 to 13,000 bushels daily, or about 4,000,000 to 5,000,000 bushels yearly. There is about 1 load of coal or coke dust to every 4 or 5 loads of shells. The coal or coke dust costs about $1 per load. Sometimes they get it for nothing. Three men can do all the work around three kilns. There is no particular distance between the layers of shells, sometimes about a foot and sometimes less.


INCLINED ROADWAY TO MOUTHS OF KILNS.


THE MOUTHS OF KILNS.


SECTIONAL VIEWS OF A KILN SHOWING LAYERS OF SHELL AND COAL DUST.

SHELLS.

THE LIME SHED AND EYES OF KILNS.

SHELL LIME KILNS NEAR NEW YORK.

Fixation of Nitrogen by Plants.

Of the various elements with which it is necessary to supply the soil in order to insure its fertility, nitrogen, says the *Gardeners' Magazine*, is the most costly, and as it forms nearly four-fifths of the air, it is not surprising the question as to the fixation of free nitrogen by plants has long occupied the attention of agricultural chemists. Toward the end of the eighteenth century Senneber and Woodhouse expressed the opinion that free nitrogen was not assimilated by plants, and in this view they were some years later confirmed by Saussaure, who from exhaustive experiments concluded that nitrogen was obtained from soluble organic matter in the soil and ammonia in the atmosphere. Boussingault, who began to investigate the matter in 1837, continued his investigations for a period of twenty years, with the result that he arrived at the conclusion that plants do not assimilate free nitrogen. On the other hand, Ville believed, from the results of his experiments made during 1849 and three following years, that plants are able to assimilate free nitrogen, and he was confirmed in his belief by a repetition of his experiments in 1855 under the direction of a committee consisting of the leading French chemists of that day. In 1857, experiments were commenced by Messrs. Lawes, Gilbert, and Pugh, at Rothamsted, and continued for several years, with the result, as stated in the memoir contributed to the *Transactions* of the Royal Society in 1860, that they arrived at conclusions which fully supported the conclusions of Boussingault.

Of late years renewed interest has been evinced in the subject, and of the recent experiments those of Hellriegel and Wilforth are the most important, as they show that, although the higher plants may not directly utilize free nitrogen, some of them may acquire nitrogen brought into combination under the influence of lower organisms. The results were regarded by Sir James Lawes and Dr. Gilbert as of such far-reaching importance, in their bearing on the admittedly unsolved problem of the source of the whole of the nitrogen of leguminous crops, that they decided to again take up the question. Accordingly, experiments were commenced at Rothamsted, and are still in progress, and the report contributed to the current issue of the *Journal* of the Royal Agricultural Society by these eminent investigators is of great importance. In their able paper entitled "The Sources of the Nitrogen of our Leguminous Crops" they adduce a large mass of evidence as to the manner beans, peas, clovers, and other leguminous crops obtain nitrogen from the air. Upon the roots of these plants wart-like nodules are formed, and these nodules are the dwelling places of certain lowly organisms, or microbes, which have the property, not possessed by the higher plants, of taking up the nitrogen from the air within the soil, and of presenting it to the higher plant in such a form that the latter can assimilate it. The microbes are not regarded as strictly parasites upon the roots of the Leguminosæ, because they are serviceable to those cultivated plants; hence the association of the two is described by the name symbiosis, or a living together. From the newly recognized source of the nitrogen of our leguminous crops it is possible that results of great practical importance may be obtained.

Weeds Wanted for the World's Columbian Exposition.

Almost everybody wants to get rid of weeds, but here is a man who makes a strong appeal to be supplied with them. It is the botanist, Prof. Byron D. Halsted, of the New Jersey Agricultural Experiment Station, New Brunswick, N. J.

He says: "In order that the exhibition of weeds at the World's Columbian Exposition may be large, and representative of all sections of the country, the undersigned (having this feature in charge) respectfully asks for specimens of the worst weeds from all States and Territories.

"The collecting must all be done during the present season, and the specimens sent in for mounting, labeling, etc., by December 1, 1892."

CANADA has been given 68,471 square feet of space in the various buildings, exclusive of space yet to be granted in the agriculture and live stock departments.

A Talk with Edison.

In the New York *World* of January 17 appeared a long interview with Edison. Although written in the extravagant style which characterizes the daily newspaper allusions to this inventor and his achievements, portions of the article are very interesting. For instance, Mr. Edison was asked how electricity could be called into service in case of a war with Chile.

"That," said he, "I want to talk about. It is true I have invented an electric torpedo, the Sims-Edison torpedo, which we have sold out to the Armstrong Gun Company. It is a very fine thing. It is put on a wire, as of course you understand, and moved by electricity. It can be run out two miles ahead of a man-of-war's bow and kept at that distance ready to blow up anything in reach. It is a very pretty and destructive toy. But it is not in that kind of thing that I take pride. What I want to see is some foreign nation coming to this country to attack us on our own ground.

"That is what I want to see, and I think that electricity will play such a part in war when that time comes it shall make gunpowder and dynamite go sit in humble obscurity with the obsolete flint arrowhead and call him brother. Every electrician, when that time comes, will have his plan for making the life of his enemy electrically uncomfortable. Here is one item of defense which I have in mind.

"It is simple as A B C. I have never spoken or written about it before. With twenty-five men in a fort I can make that fort absolutely impregnable so far as an assault is concerned, and I should only need twenty-five men in the fort to do it. This is not guesswork, but a matter of absolutely scientific certainty. In fact, twenty-five men would be a very liberal garrison. Some years ago, when the wires loaded with heavy electric charges began to go up everywhere, I predicted that there would be danger of the firemen receiving deadly shock by the electricity running down the streams of water which might cross the wires. The insurance people laughed at the idea. But I tried it on a cat, and the cat and I found my theory to be true. That is to say I did, and the cat found it out if there is another world for cats. He never knew anything about it in this world.

In each fort I would put an alternating machine of 20,000 volts capacity. One wire would be grounded. A man would govern a stream of water of about four hundred pounds' pressure to the square inch, with which the 20,000 volts alternating current could be connected. The man would simply move this stream of water back and forth with his hand, playing on the enemy as they advanced and mowing them down with absolute precision. Every man touched by the water would complete the circuit, get the force of the alternating current, and never know what had happened to him. The men trying to take a fort by assault, though they might come by tens of thousands against a handful, would be cut to the ground beyond any hope of escape. Foreign soldiers undertaking to whip America could walk around any such fort as mine, but they never could go through it. It would not be necessary to deal out absolute death unless the operator felt like it. He could modify the current gently, so as simply to stun everybody, then walk outside his fort, pick up the stunned generals and others worth keeping for ransom or exchange, make prisoners also of the others if convenient, or if not convenient turn on the full force of the current, play the hose once more, and send them to the happy hunting grounds for good."

The picture raised by Mr. Edison is certainly a most beautiful and attractive one. It is nice to think of all the fine descriptive matter that could be written. Such a fort and such a warfare as Mr. Edison has planned would make old-fashioned generals and M. Detaille, of battle scene fame, turn in their graves. We should have infantry moving on forts at a quickstep, dressed all in rubber, with chilled glass soles to their shoes and non-conductor handles to their swords and guns. Generals would look much funnier than a picture from *Punch*, charging at the head of their armies riding on horses shod with rubber arctics, the generals themselves carrying large rubber umbrellas, with gutta-percha handles, over their heads.

The world owes a great deal to Mr. Edison for the things he invents, and for the ease with which he gets out of the commonplace and makes life worth living. This fact was pointed out to Mr. Edison, and then this question was put to him:

"The world owes you a great deal. How much has it paid you for the work you have done?"

Mr. Edison laughed.

"Oh, I don't know," said h "Probably as much as the world thought it was worth."

"Mr. Edison, some people think you have made untold millions. Incidentally they are glad if you have. Others say you have not made much of anything. That most of the money your inventions produce goes to make other gentlemen fat and happy. Could you take the trouble to go carefully with me over all your inventions, make an estimate of the amount of money which they produce, and give me some idea as to what share you got out of that wealth?"

Mr. Edison thought he could. First he wrote down the following list of his inventions, which, as he said, were his commercial inventions; that is to say, those which by returning a profit had proved their own success.

As he made the list he made comments on the various inventions, and that list is interesting, because, written in his own handwriting, it gives his own estimate of his personal share in the various electrical inventions with which his name is connected.

District Telegraph.—"Of that I am one-half inventor."

Quadruplex System of Telegraphy.—"That is my invention."

Stock Ticker.—"Of that I am one-half inventor."

Telephone.—"One-half my invention."

Electric Pen and Mimeograph.—"My invention."

Incandescent Lighting System.—"My invention."

Electric Railroad.—"I am one of the inventors of that."

Phonograph—"My invention."

"The district messenger service is in use in 600 cities and towns in the United States. The investment amounts to about $4,800,000, paying about 5 per cent. The system employs about thirty thousand persons, averaging $1 a day salary.

"The quadruplex system of telegraphy is in use on 72,000 miles of Western Union wire. Eleven years ago the Western Union reports stated that the quadruplex system saved $560,000 in interest and repairs. Inasmuch as every mile of wire actually built does the work of four miles of wire, the quadruplex system represents 216,000 miles of phantom wire, worth $10,800,000.

"On these $10,000,000 worth of wires there is no repairing to be done. The value of those phantom wires is, therefore, represented by a saving of $860,000 in repairs at $4 a mile annually, besides the interest on the $10,800,000 which it would have taken to build them. Three thousand men work on my duplex instruments."

"Mr. Edison, how many millions do you make out of the millions which that invention of yours creates?"

"Not many. I sold the system to the Western Union sixteen years ago for $30,000, and spent the whole of it in experimenting in trying to make a wire carry six messages instead of four. I didn't succeed. So that financially I am worse off than I would have been had I never invented the quadruplex system."

"How about the stock ticker?"

"That employs about five hundred men at work and represents an investment of $8,000,000, paying about 5 per cent a year. From that invention I have received at different times $50,000. I spent $60,000 in getting the thing up. That again was a loss."

"Now for the telephone, Mr. Edison. Everybody supposes that you and Prof. Bell have millions stowed away, made on your telephone inventions."

"Bell invented the receiver. That is the end of the telephone which you put to your ear. He was trying to use that simultaneously as a transmitter, but could not make it go. The thing, therefore, did not pay. I invented the carbon transmitter, which made the telephone a financial success by making it commercially available. Here are the financial figures on the telephone, which really stagger me now that I come to look them up. Throughout the world there are at least one million telephones in use. They pay $50,000,000 a year rental. They represent an actual investment of $100,000,000 at least, capitalized at twice that sum, and paying about $10,000,000 a year profit. That invention of mine was a very good thing for the girls, which is a gratifying thought. It employs 20,000 people, mostly young women. I got for the telephone about $102,000 in all. Taking out what I expended in experiments I probably realized $35,000 in clear profit. Bell made about half a million. Many people imagine that he made an enormous fortune, but he didn't. It was his father-in-law who made a vast fortune by getting control of much stock.

"My electric pen and mimeograph duplicating apparatus is used very largely here and in Europe. Three hundred men make a living out of it. The profits on that are not large.

"My incandescent light system is the most satisfactory to contemplate as regards the employment it gives to great numbers of men. Throughout the world 36,000 men making a living out of that invention. In my shops at Schenectady I employ 3,800 hands; at my Harrison lamp works, 1,000; in the New York works, 150. About four million lights are burning. These represent an investment of cold cash of a hundred millions. I can count up eighty-seven millions. In addition to that customers have paid twelve millions more for the installation of wires. The thing is capitalized, taking all of the companies together, at about two hundred millions, paying from 4 to 20 per cent a year. My patents on incandescent lights netted me about $140,000. I spent about $400,000 in experimenting.

"The electric railway is, of course, not such a big enterprise. I built the first in the United States at Menlo Park in 1879. It was three miles long, and on it I obtained a speed of forty miles an hour. I sold it out long ago. I did not get my money back on it.

"The phonograph is a new thing. It will take four or five years to pioneer it. It will be greater than the telephone. To pioneer a thing is to get it on its feet. It took twelve years to pioneer the typewriter. Yes, I might invent an electric typewriter, a noiseless one, but the thing is not pressing, as it is in very good condition now. I have sold the phonograph out, but about that there is a complicated story, which need not be told. I have made no money out of it, but there is one thing which I am now working on out of which I shall make money, and of which nobody can get any share except the boys here who own the thing with me. That is the magnetic concentration of iron ore. It is the latest commercial thing I have got up. I have a mill at Ogden, N. J., with a capacity of 2,000 tons in twenty hours. This is the idea briefly. Iron ore is not Bessemer ore unless it contains as little as a fifty thousandth part of one per cent of phosphorus. If it has more phosphorus than that, it is brittle and cannot be used for making Bessemer steel. We are obliged for our Eastern manufacturing interests to import Bessemer ore from Algiers, Cuba, Spain, etc., as the freight from Michigan is too expensive. We import about 1,600,000 tons per year. New Jersey contains the largest strip or area of primal rock containing ore in the United States. There is probably more ore in this State in the primal rock than in all the rest of the States put together. The magnetic concentration of that ore would produce enough to supply the United States for centuries. The process of concentration—that is, of extracting magnetically the small particles of ore from the rock in which it is scattered—makes it Bessemer ore of the highest quality by destroying the phosphorus in it. I have been for three years leasing all the available deposits of ore in New Jersey. I have secured eighteen square miles of mineralized rock now. This will be for me a regular Standard Oil enterprise. In six or eight years I shall take out ten or twelve million dollars' worth of ore a year, at a profit of about three millions a year clear. I have now in contemplation eight mills.

"From my various patents, so far as the patents themselves go, I have stood an actual loss in experimenting and in lawsuits of $600,000. I should be better off if I had not taken out any patents. I do not mean to say that I am a pauper, as you might think from my talk. But my money has not been made out of patents, or out of any protection that the Patent Office has given me. I have made it all out of manufacturing, and I have made quite enough to pay for my experiments and to get a good living, which is all that I care about."

"Mr. Edison, Chauncey Depew in his speech at the World's Fair dinner commented on the fact that whereas in the exposition in Philadelphia there were only a few overhead wires to tell the tale of electrical inventions, the Chicago exposition will contain a building of great size, devoted exclusively to the progress of electricity, and filled with machines, nearly all of them the work of one man. If you were to try, regardless of space, how big an exposition of your own work do you think you could get up? How many machines have you worked on in your life?"

"Well, it would be hard to say. I have worked on as many as forty machines at one time. An exhibition of all the machines that I have worked at and experimented on, if I had kept them, would cover about twenty-five acres."

Silver.

If silver keeps on the down grade in price, some more of the big mines of Butte, Montana, will have to cease operations. The Clear Grit and Black Rock closed recently. The Granite Mountain, of Montana, and the Ontario, of Utah, are two of the great silver mines of the country which can keep on some time longer, but few others can.

The outlook for silver at this session of Congress does not appear to be very good, and its friends are not so hopeful as before the session commenced.

The gradual drop in the price of silver is very discouraging to the miners in the silver camps. As there are more silver mining camps than gold, this greatly affects the mining industry. In some of the big camps work is bound to give out for the men unless there is a change for the better shortly. Not only must those mines now opened curtail operations, but new ones will not be developed until the prospects are better than at present. Ores of gold, copper, and lead will be more in demand for awhile until the silver question is settled. It is most unfortunate that it should have got into politics.—*Min. and Sci. Press.*

SODA-SALTPETER, $NaNO_3$, is found in extensive deposits of thicknesses ranging from 0·3 to 1·5 m., and 30 miles long, in the middle part of the rainless west coast of South America, principally in the south of Peru and north of Chile. According to these principal mining places it is in commerce called Chile or Peruvian saltpeter. The saline masses there deposited consist in pure, dry, and hard saltpeter, lying almost bare and immediately under the surface. It is supposed that the beds have been formed of rotting seaweeds in presence of sea salt.

The Decomposition of Water.

Lord Rayleigh, delivering a lecture at the Royal Institution on the decomposition of water, recently, explained the latest methods of doing so by experiments. He said, in order to form water, it was necessary to take two volumes of oxygen to one of hydrogen. From that point of view the constitution of water was perfectly well known. But there was also the question of the relative weights of the two bodies, and how far the ratio of two to one really represented in the matter of volume the facts of the case. If the ratio in volumes were always the same, the question of weight would be the same as that of the relative densities of the two gases. In round numbers the weight of oxygen was sixteen times that of hydrogen. According to Prout's law, these ratios were always represented by some exact multiple. Thus, if hydrogen was taken as the unit, oxygen would be 16 and carbon 12. The question of atomic weights and relative densities was primarily experimental, but there was great danger of twisting *data* so as to meet the requirements of a preconceived idea. The investigations of chemists with respect to hydrogen and oxygen had varied, but not within great limits. In 1842, Dumas thought that the weight of oxygen was 15·96 times that of hydrogen, and Regnault, in 1845, came to the same conclusion. It was, of course, not improbable that this slight deflection from the exact number 16 arose from error of calculation. For a long time this question slumbered, and it was not for forty years that attention was again directed to it. He had himself, in 1888, arrived at the conclusion that the right proportion was 15·884 to one; and other chemists, both in Europe and America, had published the results of their inquiry, which all gave figures between 15·7 and 15·9. The real difficulty arose from the extraordinary lightness of hydrogen, which was only $\frac{1}{14}$ as heavy as the air. The glass in which the weighing was done might be 200 grammes, while the hydrogen contained therein was only $\frac{1}{10}$ of a gramme. Our brass and platinum weights were accurate enough to record infinitesimal weights; but that was not the crux. The atmospheric conditions might cause a greater disturbance than the weight of the hydrogen. To meet this difficulty Regnault had devised a method of weighing two glass vessels as similar to each other as possible against each other, so that each would be affected in like manner by any sudden change of external conditions. The effect of moisture or changes of barometric or thermometric conditions might be very different as between platinum weights and glass; but with two glass vessels constructed precisely alike the difficulty was eliminated. Lord Rayleigh then explained and illustrated the decomposition of water and the desiccation of the hydrogen so as to make it absolutely free both from oxygen and moisture, which was effected by means of passing it through phosphoric anhydride.

The Invention of the Submarine Armor.

In an article on the history of the mechanical arts published in *La Nature* of December 5, 1891 (reproduced in SCIENTIFIC AMERICAN SUPPLEMENT, No. 837, page 13368), one of the most striking figures, says Mr. Berthelot, of the Institute of France, is the one relative to the submarine armor, and which shows that this existed as far back as the beginning of the fifteenth century. "Having since found various new data upon this subject," says Mr. Berthelot, "it seems well to me to reproduce them briefly."

The idea of supplying air to divers submerged in water is very ancient. In the Problems attributed to Aristotle (section xxxii., § 5), we read the following passage:

"When an inverted vessel is let down to divers, it facilitates their respiration. The vessel does not fill with water, but retains the air. Moreover, it is only through force that it is made to descend in the water, for the vessel is kept perfectly upright, and, however slightly it be inclined, the water rushes into it."

Many attempts must have been made in the course of time to supply air to divers, although no trace of them has been pointed out up to the present. The apparatus figured in the memoir of Munich is the most ancient one known, but the tradition of the submarine armor starting from the fifteenth century is attested in an uninterrupted manner by authentic documents. In certain editions of Vegetius, such as those of 1532 and 1553 (both of Paris), we see, on pages 106-107, 176-177, and 180-181, figures of armored and ordinary divers, like those of the MSS. presently to be mentioned, and of which they appear to be the prototypes. In consequence of a singular error, some persons have attributed these figures to Vegetius himself, who says not a word about them. They are really the work of the editors of the sixteenth century, as the aspect alone of the persons shows at a glance. Mr. Berthelot has found similar figures in the French MS. No. 14,727 of the National Library, written in the first half of the seventeenth century, and which was the note book of a French engineer. On the recto of the fifth, last but one folio, we see a diver with his costume and his air tube alongside of a large reservoir designed to supply him with the air necessary for his respiration. On the verso there is another figure of a diver entirely analogous to that of the Munich MS.; and, alongside, a man provided with a sort of swimming belt. On the folio following, there is a naked man under water breathing the air contained in a bladder, or rather a leathern bottle. This represents a much more primitive type, and one analogous to that of the Problems of Aristotle. The armor of the diver was partly of leather and capable of being inflated, so as to perform the role of swimming belts, as appears from the figures found near the middle of MS. No. 14,727, and which are like those of the Munich MS., but accompanied with an explanatory legend: "Various kinds of leather belts, which are to be inflated with air in order to cross a river." Beneath, there is an inflated leather bottle designed to be affixed thereto.—*La Nature.*

CHARLES J. VAN DEPOELE.

This eminent electrician and inventor died at his home, Lynn, Mass., March 18. For the accompanying portrait, reproduced from the last photograph for which Mr. Van Depoele sat, and for the following details we are indebted to the *Electrical Review.*

The deceased was born in Lichtewelde, Belgium, April 27, 1846. When but a boy the first telegraph line was put through near his birthplace, and from watching the operations he became much interested. With what little money he could get by running errands and doing odd jobs for the neighbors he bought himself a couple of battery cells and some instruments, and from that time was constantly experimenting. At one time he had a battery of over 100 cells, which, owing to the opposition of his father, who looked upon electricity as nonsense, he was compelled to hide in a loft in the house in which he lived, and there, on his father moving to another place, they were left. He continued his experiments, spending every spare moment he had in that way, and every cent that he could get went to buy apparatus.

CHARLES J. VAN DEPOELE.

When about 15 or 16 years of age his father apprenticed him to a church furniture and fancy wood carver in Paris, where he soon became master of the trade, devoting his evenings and oftentimes sitting up until daylight experimenting. He continued in this business until, in 1871, he came to this country and settled in Detroit, Mich., where he started a shop of his own, being at the head of 200 hands at one time.

His father, who had followed him here, and his many friends objected to his persistent experimenting and wasting of money, as they were pleased to call it, and met to have him sign papers agreeing to give up his experiments altogether. The meeting had just an opposite effect, and young Van Depoele swore that from that time on he would devote the whole of his time and money to the study of electricity. Accordingly, he placed his father at the head of his shop and, building a little place of his own near his residence, worked altogether at developing his ideas. Becoming interested in the electric light about that time, he constructed a dynamo, and in 1880, after moving to Chicago, formed the Van Depoele Electric Light Company, with A. K. Stiles at its head. The following summer he lighted some of the streets in Chicago gratis, and soon the company made and carried out numerous contracts.

As soon as this company was fairly started he began advocating the idea of running railways by electricity, contrary to Mr. Stiles' wishes, who thought nothing would come of it. Van Depoele was undaunted, and in 1883 he obtained Mr. Stiles' consent to put up a short exhibition railway in Chicago. Seeing the success of this, Mr. Stiles became enthusiastic, and from that time on offered no opposition.

In 1884 he constructed a conduit road at the Toronto (Ont.) Exposition, followed in 1885 by the overhead system in the same place.

During the next three years he was busy developing the electric railway, taking out many patents and building several railways in Toronto, Ont., South Bend, Ind., Minneapolis, Minn., and other places. In 1888 the Thomson-Houston Company, of Lynn, observing the success of his railway, bought out all of his railway patents, and in March of that year he came on to Lynn and was connected with the company ever since as electrician and inventor.

It was also by his untiring efforts that the electric percussion drill was brought to its present state of perfection, he having begun his experiments in that field as far back as 1882. Thinking that electricity could be used in the exploitation of mines, he talked with Mr. Stiles about the matter. Mr. Stiles immediately offered him money to carry on experiments, and he soon evolved a drill. Two were manufactured by the Thorn Wire Hedge Company, of Chicago, and experimented with in the company's shops. They were powerful enough to knock to pieces some very large stones on which they were used. Much encouraged, he continued his work, taking out numbers of patents and developing and improving the machines, until now the result of his exertions is seen in the mining drills, pumps, hoists, etc., of the Thomson-Van Depoele Electric Mining Company, whose patents were lately bought out by the Thomson-Houston Electric Company. Though much interested in all branches of electricity, it is the electric railway and electrical reciprocating devices that owe most to him. At the time of his death he was developing and improving his apparatus in the latter field.

Impeding Patent Office Business.

The many ways in which the business of the Patent Office is being constantly retarded by the insufficient appropriations of the government for the proper maintenance of the work of this bureau has been a matter of frequent comment for several years. With the growth of the business of the office there has been no adequate preparation for its natural expansion, and the Commissioner has just been obliged to issue a brief official notice to the effect that "in consequence of want of room for the proper storage and arrangement of printed copies of patents, it will be impossible to fill orders in current issues until additional room is provided by the proper authorities."

Those who are now obtaining patents from week to week are likely, therefore, to have some trouble in obtaining duplicate copies of any patents issued after March 8, and may in some instances be subjected to annoying delays, although copies of issues of an earlier date are obtainable as usual. Congress has failed from year to year to provide room for this rapidly growing, money earning institution. Its examiners and clerks are packed into rooms so small they can hardly breathe, and its immense mass of valuable records are stacked up on triple rows of pine shelves in the corridors, where moth and dust may easily corrupt and where a fire may break out if thieves do not break in. Now even this space is exhausted, and copies of patents now being issued cannot be stored, so that copies can only be obtained with difficulty and delay. It is certainly high time that some measure of effective relief was provided.

To Make Wax Sheets.

I have used the following plan for the last fifteen years: After the wax is properly cleaned, get four pieces of glass cut the width you want to have your sheets and about ten inches long. Any deep vessel, such as a dinner pail or an old oyster can, will serve to melt the wax. Put the pieces of glass in a pail of cold water; when the wax is melted, take two pieces of the glass, one in each hand, and dip alternately, one cooling while you dip the other (about three or four dips is sufficient), then drop into the cold water. Let these two remain till you dip the other two in the same manner. By trimming the edges off the glass with a knife, the sheets will drop off themselves. If the wax is kept too hot, the sheets will be too thin; if too cold, they will be lumpy and thick. Near the setting or cooling point is the proper temperature. A tablespoonful of Venice turpentine to three or four pounds of wax will toughen it. This should be evaporated to dryness like resin. It can sometimes be obtained in drug stores in this form. It will answer the purpose even if used thin, but the thicker it is the tougher will be the wax sheets.—*Dr. Beacock, Dom. Dent. Jour.*

Double Carbon Lamps.

On March 1 the Brush Electric Light Company scored an important victory in court. In its suit against the United States Electric Lighting Company, asking for an injunction restraining the latter company from using the double carbon lamp, which was patented by Charles Brush, September 2, 1879, the court granted a perpetual injunction, and ordered that testimony be taken of the amount due the Brush Company for infringement of the patent.

RECENTLY PATENTED INVENTIONS.

Railway Appliances.

CAR COUPLING. — Lewis S. Riggs, Selma, Ala. This invention provides a simple and light construction to substitute for the usual drawhead, when the latter is broken or disabled. It consists of a jaw bolt having a shank adapted for insertion through openings in the frame plates, and having at its front end jaws with an intermediate slot to receive a link, the device being light and inexpensive and suitable for convenient carriage in the caboose. If two meeting drawheads become disabled, a jaw bolt can be substituted for each, the substitution being quickly effected, and the device forming an efficient temporary coupling.

CAR COUPLING. — Arthur Parkinson, Vian, Indian Territory. This coupling comprises a forked drawhead, in one member of which a toothed wheel is pivoted to project into the central opening of the drawhead, a spring-pressed pawl pivoted in the drawhead engaging the toothed wheel, while there is a lever mechanism for turning the pawl against the spring. The mechanism is extremely simple, two drawheads coming together necessarily coupling automatically, while the uncoupling is effected by simply turning a crank, without danger to the brakeman. The device may, if necessary, be used with the old fashioned coupling.

CAR COUPLING. — James R. Williamson, Fancy Bluff, Ga. A slotted pin is mounted in the drawhead of this coupling, which has a recess in its top, a lever pivoted in the drawhead extending through the pin, while a forked bar mounted on the drawhead has one end extending downward through the recess, there being a roller mounted in the bar beneath the lever, and means for lifting the bar. The common link is used, and the link-lifting and guiding attachments employed may be easily applied to a common coupling. By this coupling the cars may be automatically coupled, and may be uncoupled from any convenient point upon a car, while means are provided for guiding a link so that it will readily enter an opposing coupling.

CAR BRAKE. — John Morrow, New York City. Toothed wheels are secured on the car axles, and the brakes, between opposing toothed wheels, are provided with sliding shoes, there being a rocking mechanism connected with the brakes and a shifting mechanism with the brake shoes. The invention is an improvement on a former patented invention of the same inventor, whereby the brake may be controlled from the engine, and expeditiously applied to cause a quick and close pressure of the shoe on the wheels, the wheels also being quickly forced, after the brake is applied, to turn a limited direction the reverse of their forward movement, giving to the wheels during the act of braking a rolling motion upon the track in a direction opposite that in which the train is traveling.

CAR BRAKE. — William T. Rickman, Fern Bank, Ala. This is an automatic brake in which the brake mechanism is put in operative position by the pressure of the preceding car upon the drawbar. Certain details of mechanism are also arranged to be operated by the car axle to automatically throw the brake mechanism out of operative position when the car is backed, and which will be shifted to allow for automatic operation when the car is again moved in a forward direction. This mechanism is designed to be cheap and simple in its construction, and effective and positive in its operation.

CAR HEATING DEVICE.—Hugo Newman, New York City. This invention provides a mechanism of simple and inexpensive construction, designed to generate heat by means of friction in sufficient quantities to warm the car, the mechanism being operated from the axle. The apparatus consists of parallel plates of metal between which piston heads are held to slide in positive engagement with the plates, the piston heads being provided with cushions of rubber or like material adapted for engagement with the metal plates, there being a mechanism for reciprocating all the heads simultaneously. The rubber caps are treated with amalgam, so that they will not wear rapidly, and in street cars one of these mechanisms is designed to be placed under each line of side seats.

COMBINED FROG AND SWITCH. — David Horrie, Antigo, Wis. This is an improvement on a former patented invention of the same inventor, in that class of railroad frogs in which a swinging rail is employed adapted to align with the main track and an intersecting side track. The swing rail frog and the shifting rails of an adjacent switch are provided with operating mechanism to be actuated by a locomotive or cars moving on the main track or siding, to automatically adjust the swing rail of the frog and the laterally movable rails of the connected switch in alignment with either a main track or a side track.

TANK FEEDER. — Merritt Burt and John W. Skilton, Jacksonville, Fla. The trains moving on a railroad are, by this improvement, utilized to directly and positively raise water and automatically discharge it into the track tank. A frame over a reservoir supports a track tank and an elevated guide pulley for a hoisting rope by which the bucket is raised. The bucket is held in elevated position by a detent mechanism, and its descent is regulated by a brake, the pulling rope being connected with the cars moving in either direction to elevate the bucket. The bucket has a lateral discharge opening near its bottom, the valve controlling which is automatically opened when the bucket reaches its uppermost position.

Electrical.

CONTACT MAKER. — Daniel Draper, Hastings-on-Hudson, N. Y. This is a positive device for use in clocks, meteorological instruments and similar purposes in which positive electrical impulses are automatically sent at intervals. An armature is attached to the contact-making arm and a magnet arranged in such relation to the arm as to engage the armature and hold the contact arm down against the contact point with sufficient force to prevent it from vibrating, so as to produce more than one contact with the point.

Mechanical Appliances.

STOP MOTION DEVICE. — Richard Whitaker, New Brunswick, N. J. This device is designed more particularly to stop the rotative movement of a driving shaft in crank presses, etc., the construction being simple, and affording means to quickly arrest motion in a machine and start it instantly when required. The driving shaft is mounted in a frame, and there is a loose pulley on the shaft, while a longitudinally locking bolt carried by the shaft is adapted to engage the pulley, an abutment being also carried by the shaft, a spring between the bolt and abutment, and a spring-pressed wedge-shaped bar adapted to engage the locking bolt and disengage it from the pulley.

PHOSPHATE ROCK SEPARATOR.—George W. Veronee, Ten Mile Hill, S. C. This is an improvement in rock catchers to be used with the common cylinder washers employed to wash and clean phosphate rock and ores, the catcher causing the mud, fine rock and trash to be quickly separated and delivering the rock to the washer. Combined with the washer and its feed screw is the perforated cylindrical catcher, secured to the lower end of the washer, the catcher having a perforated end flange and inwardly projecting curved and perforated flanges arranged to deliver upon the feed screw.

QUILLING MACHINE. — Herbert G. Pounds, New York City. This invention provides a doubling attachment for quilling machines especially adapted for use in quilling silk. It is a simple form of quiller, doing away entirely with the ordinary doubling machine and doubling bobbins, winding and doubling the silk directly from the winding bobbins, and in a perfectly even manner, and when a bobbin is emptied or a thread broken it immediately stops the spindle. The attachment consists of a frame pivoted in supporting brackets, adjustable balance weights held on its under side, a series of tension hooks pivoted on the frame pivot and extending above the front end of the frame, an arm being secured to the rear end of the frame and adapted to connect with a spindle stop motion.

TOOL HANDLE. — Wallace L. Smith, Richburg, N. Y. The body bar of this handle has a socket at each side of which clamping jaws are held to slide on the bar, sleeves surrounding the clamping jaws and a portion of the body bar and engaging them for imparting movement to the jaws. The handle is designed for such tools as augers, bits, reamers, etc., and is capable of being readily and conveniently applied to the shank of the tool and quickly disengaged therefrom when desired.

LUBRICATOR. — Nelson Guyer, Ethel Landing, Pa. This invention provides a simple and inexpensive cup, which will not need to be filled very often, is adapted to use any kind of a lubricant, and may be instantly adjusted to feed either fast or slow, as desired. The device is especially adapted for use on engines, pumps, drilling machines, etc., a handle being turned down, if the oil is to be fed rapidly, so that a bore of the nipple and an opening in the hollow core will register, the oil flowing through the registering openings, but if the oil is to be fed slowly, another turn of the handle will cause the oil to follow a groove to the bore of the nipple.

Miscellaneous.

FANCY BOX.—Alfred G. Williams, Newark, N. J. This invention relates to an improvement in boxes to hold toilet articles, tableware, jewelry, etc., providing means whereby the body may be inexpensively and readily constructed of a thin metal, and an irregular contour given to it as readily as an angular or triangular shape.

STAMP HOLDING APPARATUS.—James Hoop, Ogden, Utah Ter. This is an apparatus adapted to hold or carry rubber hand stamps, carrying a large number of dissimilar stamps, and also holding them automatically upon an inking pad so that they will be always ready for use. The apparatus has a returning mechanism, to return a stamp to its seat upon a pad after it has been used, with a labeling system whereby any stamp desired may be found at once. The apparatus may be placed in a convenient position above a desk, table or other article of furniture, and is adapted to save time by carrying the stamps in the most convenient manner possible.

MUSIC BOX. — Alfred Wolff, Rutherford, N. J. This is a box of simple and durable construction, arranged to open and close the bearings for the pin cylinder for conveniently changing the cylinders without danger of injury to the pins. The invention consists of a pin cylinder secured on a shaft, a spring-pressed lever pressing on one end of the shaft, and a sliding pin against which the cylinder is pressed by the lever, there being a mechanism for simultaneously opening the bearings for the pin cylinder shaft and a spring for pressing the cylinder.

DOOR CATCH. — John J. Martz, Big Rapids, Mich. A retaining and impinging bar or staple is fixed on the interior of the framework of the door inside the plane of the closed door, to act as a stop to the door, in combination with a bent spring catch attached to the door and adapted to project beyond and lock inside of the retaining bar. It is an inexpensive, simple, and almost universally applicable device, which may be located at the top, bottom or side of the door.

CHIMNEY CAP. — Joseph A. Hodel, Cumberland, Md. This improvement relates to that class of chimney caps in which a vibrating valve is employed, which is automatically adjusted by the wind pressure to prevent a downward draught, and to increase the up or suction draught. The base plate has an upwardly and outwardly flared flue opening, oppositely projecting hood portions formed with inwardly and downwardly extended flue members communicating with the central flue opening, while valves are mounted in the hood portions, to be closed over the flue members by the wind pressure, with means for normally holding the valves open.

WASH BOARD.—James Pittigan, Goodland, Ind. The rubbing face of this wash board is made by two series of cross-hatched wires, the inner series being vertical, and forming unobstructed channels under the rubbing surface, while the outer series is horizontal and made of somewhat larger wire than the inner series. At the points where the horizontal wires cross the vertical ones the wires are soldered together, to prevent rust. The wires are preferably spaced about five-eighths of an inch apart.

BALING PRESS. — Andreas Mattijetz, Giddings, Texas. This invention covers an improvement on a former patented invention of the same inventor, the press being simple and durable in construction and more especially designed for rapidly and conveniently baling hay and like material into large or small bales. The follower is provided with uprights extending through the top of the follower chamber, friction rollers on the outer ends of the uprights traveling on the top of the follower chamber, set screws on a cross bar of the uprights being adapted to engage the friction rollers to brake them. The press is preferably made of channel iron, that it may be very light and strong.

FIRE BOX AND GRATE. — James A. Jamison, Russellville, Ark. This fire box has a back piece with a supporting bar on its front side, side pieces having their rear ends secured to the back piece, a removable supporting bar connecting the front portions of the side pieces, and removable grate bars extending between the front and rear supporting bars. The bolts which hold the parts of the box together are arranged so that they will not be exposed to any great amount of heat, and the parts are put together in such a manner that if any portion of it breaks, the broken part may be easily and cheaply renewed. This fire box and grate is especially adapted for use in fireplaces or open stoves.

VEHICLE. — Jacob Ruch and Emanuel Stair, Mount Eaton, Ohio. According to this invention the vehicle body is freely suspended on its springs, its front end being suspended from the cross bar of the shafts, whereby the body will have a swinging movement designed to render it very easy to a person riding in it. Bars secured to the axle have upwardly projecting posts to which the thills are connected, the body having its front end supported from the thills and its rear end supported from the axle, to have a yielding and a lateral swinging motion.

VEHICLE RUNNING GEAR. — John R. Kunzelman, Stillwater, Minn. This is an improvement on a former patented invention of the same inventor, relating to running gear for wagons, bob sleds, etc., in which the reach is adapted to rotate, being connected with the axles by universal joints. According to this improvement racks and pinions are employed as the means of connection between the reach and axle bounds, there being stops to arrest the rotation of the reach to limit the angle which the rear axle may assume to the reach, while permitting the front axle to assume a greater one, as required to facilitate the turning of short corners.

SNAP HOOK. — Horace N. Bull, David Dickey, and Homer F. Hutton, Ennis, Montana. This is an improvement in that class of snap hooks which are provided with a pivoted device for locking a trace loop or chain link and in the hook proper. The hook has a lengthwise mortise in its body and a notch on its end, a latch pivoted in the mortise having a lug in its rear side, while a disk pivoted in the rear of the latch has a slot to receive its lug, a spring bearing on the disk.

INKSTAND FOUNTAIN ATTACHMENT.—Joseph H. Hamill, Globe, Arizona Ter. A sack of rubber or other elastic material is adapted for attachment to the neck of the inkstand or well, a funnel of hard material having its lower end attached within the sack, while an apertured mouthpiece is connected with the upper end of the funnel and covers it. The attachment may be quickly and readily applied to any inkstand, and the receptacle or mouthpiece from which the ink is taken by the pen serves also as a cap to prevent the entry of dust.

VIOLIN BOW.—Frank Searle, Virginia City, Montana. This invention provides an improved means for securing the hairs of the bow to the handle or staff. It consists of a clamp with two plates between which the hair is placed, one of the plates being rounded off at one end for bending the hair over it, there being set screws for fastening the plates together, the set screws being oppositely arranged to pass the hair between the two set screws and between the two plates. The hair can be readily spread to the desired width and thickness by adjusting the screws, and is tightened by adjusting the handle piece in the usual manner.

WHISTLE HARP. — John P. Nessle, Newark, N. J. This is a simple instrument to be played by blowing into it. It has a tubular body, with a mouth opening at one end, and longitudinal slots on opposite sides to permit the escape of air. There are also other aligning slots or openings over which extend metallic tongues, which vibrate to produce musical sounds as the air passes outward through the openings, the tone being varied to produce a tune by working the tongue in the same manner as if whistling without the use of an instrument.

SPOON.—Austin F. Jackson, Taunton, Mass. This spoon has the forward end of its bowl centrally divided with a short slot or incision, and a middle ridge extends therefrom down into the bottom of the spoon, thus making an improved form of spoon for eating oranges out of the rind after having been divided into hemispheres.

CLOTHES PIN. — William J. Blakey, Auckland, New Zealand. This pin is made of two sections of spring wire united at their upper ends by a common shank and separated at their lower ends, the lower ends being contracted to form tapering openings, and the shank having a hook at its upper end and a spring below the hook. This pin is adapted to clamp two adjacent articles, and permit one article to be removed from the line without disturbing the other, the pin being also capable of movement upon the line while attached to it.

CLOTHES POUNDER. — Alphonse Rousseau, Fall River, Mass. This is an improved device to facilitate the washing of clothes without the use of a rubbing board. The shell of the washer is bell shape, with a socket at the top in which the handle is secured, and within the shell is held a transverse partition with a central valve connected by a spiral spring with the handle socket. There are openings in the upper portion of the shell, and the up and down movement of the washer, forming a partial vacuum, forces the water through the clothes in opposite directions.

PEANUT WARMER.—Charles E. Raper, Big Rapids, Mich. This is a simple and inexpensive device, light and durable and occupying but little space, and easily managed, to readily warm nuts without danger of burning them. It has a hollow base having a door and a perforated floor, a removable drum mounted upon the base, an oven suspended within the drum, and a dome mounted on the drum to cover the oven, the dome terminating in a chimney. The smoke and gases pass upward through the perforations of the oven and escape through the chimney without in any way affecting the nuts. The warmer may be readily taken apart for cleaning or shipment.

GAME APPARATUS. — Alexander W. McArthur, San Francisco, Cal. The game board provided by this invention has, between inner and outer circles, a series of small circles to be filled by portraits of prominent authors. On the spinning of a centrally pivoted hand the player is required to name the author whose portrait appears in the circle where the hand stops, and to give a quotation from some of his writings, the game admitting of the introduction of many variations.

HEAD REST.—John H. Barth, Batesville, Ind. This is a removable, readily attachable, and otherwise convenient and desirable head rest for chairs or seats, designed more especially for use by railway passengers, permitting each person to carry his own head rest. It is made of spring wire with a cloth or other soft covering, and consists mainly of two spring wire frames or side pieces, detached from each other, but adapted to be connected by an engaging and disengaging wire stretcher at or near their tops, the covering constituting an easy cushion for the head.

COFFIN HANDLE.—Lyman E. Woodard, Owosso, Mich. This invention relates to coffin handles having a drop handle bar, and provides an improved folding bracket arm for the support of the drop handle bar. The invention is an improvement on a former patented invention of the same inventor.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention and date of this paper.

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The Hall & Cook post hole digger (see advertisement, page 220), patented U. S. Jan. 26, 1892, has won a brilliant place among its users in Canada. Already the Canadian Pacific Railway has adopted it, and the Grand Trunk Railway took its adoption into favorable consideration just as frost set in. It is heartily indorsed by Hon. John Dryden, Minister of Agriculture for Ontario, besides a host of farmers, etc., who have thoroughly tested it. Judging from the favor it has already received with railway, telegraph and telephone companies, farmers, well and drain diggers, etc., it will be as indispensable as the spade has been in the past.

Notes & Queries

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Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(4207) C. M. M. asks if there is anything that can be put in water so that by heating a piece of cast steel and plunging it into the water it will come out annealed. A. There is nothing needed in the water for "water annealing." The process is simply to heat the steel to a low red heat and allow it to cool slowly in hot ashes until it looks black or the red heat is entirely gone, then plunge in water.

(4208) H. M. B. says: Two miles from the city of Quito in Ecuador, and 1,600 feet above its elevation, there is a waterfall that would fill a pipe 12 inches in diameter. If that water was piped down to the city in the best iron or steel piping, what thickness of pipe would be required at the lower end to withstand the strain? A. Wrought iron pipe 12 inches is amply strong, if about ⅛ inch thick. The pressure is too great for a city water supply. Extra strong plumbing will stand a water head of 200 feet, at which height a reservoir should be placed and the water brought to it by a free run through ordinary pipe with an overflow waste. This is far better than any attempt to run a high pressure service.

(4209) C. H. asks: 1. Is it necessary for one desirous of learning any of the type-setting or type-casting machines to first learn the art of setting type by hand? A. It is not absolutely necessary, if one knows how to punctuate, capitalize, paragraph, read difficult manuscript, etc., with the facility and correctness usually acquired by the compositor in learning to set type. 2. Where is the Rogers typograph machine manufactured? A. Cleveland, Ohio. 3. Is it probable that a machine will be invented that will print short hand characters as the ordinary type are printed by these machines? A. It would be as easy to print short hand characters as Roman, but there is no call for a machine for such work.

(4210) V. D. R. writes: 1. I am a student of the high school of this place, and in one of our experiments in chemistry we were directed to take a piece of sodium and hastily plunge it under the mouth of a test tube inverted in water in a larger dish. In about nine cases out of ten an explosion takes place. Will you kindly inform me through Notes and Queries the reason of the explosion, which does not occur when potassium is substituted for the sodium. A. This is a phenomenon of the spheroidal state. The heat is at first so great as to prevent full contact of sodium and water. When the heat falls and contact occurs, the sudden heating produces an explosion. Potassium acts in the same way; neither should be used unless they are held under water. Both experiments are dangerous. 2. Also please give me equation for action in Leclanche cell. A. It may be written thus: $Zn + 2NH_4Cl = ZnCl_2 + 2H + 2NH_3$, but is undoubtedly complicated by other reactions. 3. Is it necessary to wind secondary coil of an induction coil in opposite direction to that of primary? If so, why? A. No. 4. Is there any galvanic cell which has chloride of lime in porous cup with carbon and common salt in outer cup with zinc? If so, will you please give its E. M. F. in volts? A. You are thinking of Niaudet's battery. Plate of zinc in strong solution of common salt, porous cup containing plate of carbon and packed with chloride of lime and fragments of carbon. E. M. F. 1·65 running down to 1·5 volts. Resistance high, no action on open circuit.

(4211) F. L. W. asks: Can you tell me of a test that will indicate the presence of a very small per cent of dissolved copper in water? Say one-tenth of a grain or less in a gallon of water. A. Excess of ammonium hydrate produces blue coloration in solution of copper. A very slight excess is enough. Possibly in your case it would be well to evaporate the water down in a porcelain dish or other vessel to about one-tenth its volume, acidify, filter and add ammonia water. Add enough to react on litmus paper or to give a perceptible odor of ammonia.

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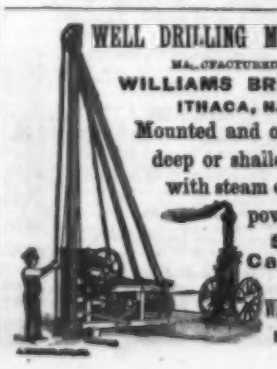

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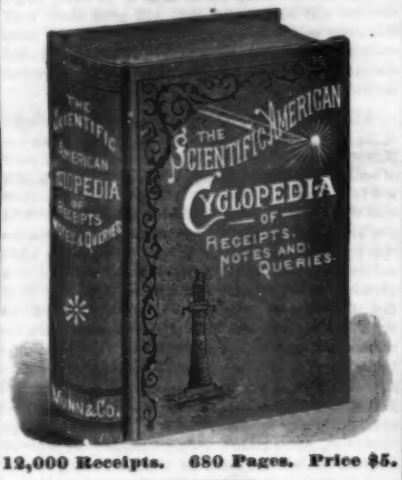

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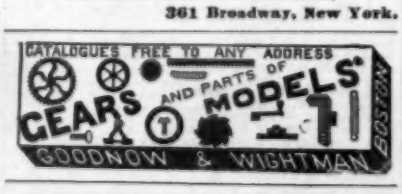

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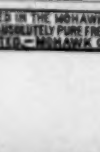

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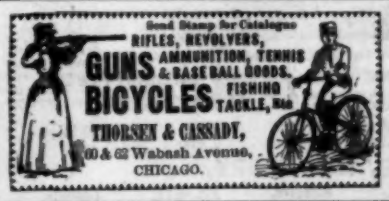

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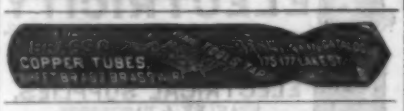

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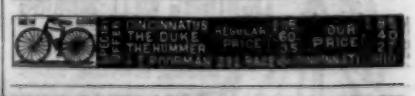

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